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Morning walks, or, Steps to the study of mineralogy

Author of Morning conversations

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MORNING WALKS;

OR,

STEPS

TO THE

STUDY OF MINERALOGY.

LONDON:

HARVEY AND DARTON,

GRACECHURCH STREET.

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MORNING WALKS IMPROVED.

CHAPTER I.

ELIZABETH and Jean had a most agreeable visit to their kind aunt, who was very fond of them, and always exerted herself to make their time pass pleasantly and profitably while with her. She had been a widow many years, and having lost her last surviving son by a fall from his horse, about two years before this visit, she had little to bind her to this world, but her affection for her brother and his family. She had, with pain, observed Jean's impetuous temper, even in infancy, and had urged the necessity of adopting some other method for the correction of it than had till lately been pursued. It was by her advice that Mrs. M'Ivor had given up the superintendence of her children's education, to which her praiseworthy attention to the wants and wishes of her aged and afflicted mother would not allow h r to de-

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vote so much time as the number and different dispositions of her children required. Mrs. Stewart was, therefore, most anxious to ascertain whether any change was observable in Jean's habits, and if the present system was likely to be conducive of lasting improvement in her temper and disposition. She was possessed of too much sense and judgment to suppose that any very great alteration could have taken place in the few months that Miss Angerstein had been with her nieces; but she also knew, that if the work of correction was merely begun, it could not but be productive of good, and would most certainly show itself during the time Jean was to pass at Balloch Gowan.

Very soon after their arrival, Elizabeth and Jean asked their aunt if she had ever seen Miss Angerstein; and upon being answered in the negative, they endeavoured to make Mrs. Stewart comprehend what sort of a person she was.

"She is not at all pretty, aunt," said Jean.

"But mamma says she is quite the gentlewoman in her appearance, and lady-like in her manners," said Elizabeth.

"Which is far preferable, my dears, to beauty, in every station of life; and when joined to an amiable disposition and a cultivated mind, will make even a plain person pleasing."

"You know, aunt, I am no judge," said Elizabeth; "but Miss Angerstein appears to be very well informed, for she explains every thing so clearly

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to us; and papa says she converses well. I know you would like her, for she is gentle, mild, good-tempered, and cheerful."

"I am convinced, my dear, she has won your heart, by the way in which you speak of her; and from your mamma's account of her, she is deserving your affection."

"Indeed, aunt, she is very kind to us," said Jean; "and though I was very troublesome when she first came, you cannot think how patient she was with me; but she seldom lets me have my own way."

"Because what you call your *own way*, Jean, is not the right way. You were, indeed, *very troublesome;* and fond as I am of you, the irritability of your temper was so great, that I generally saw you return home without regreting your departure. I have been making my observations on your conduct since you came to me, and I am most happy to say, my dear little girl, they are favourable. You are by no means cured of your many faults, but you appear to be desirous of checking them, and that is the best way to get rid of them entirely."

ELIZABETH. I am sure you would say so, aunt, could you see Jean at home with her sisters and little brothers. Some time ago she would not give way to them in their plays and infantile amusements, which certainly are not quite suited to her; but she is very good to them now, and plays with them whenever they ask her.

"I am very glad to hear this; for though their

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game may not be quite suitable to Jean's age, yet it is always desirable she should endeavour to please, by sacrificing her own inclinations and pursuits to the occasional amusement of her younger brothers and sisters. This will endear her to them, and will bring its own reward, in the satisfaction Jean will feel, from having been obliging to those whom it is her duty to love and cherish. But get your bonnets on; I am going out to see two or three of the cotters, and you may as well walk with me."

Elizabeth and Jean were soon ready, being always glad to accompany their aunt in her visits to her poorer neighbours. The country here was very different from the lovely valley in which Inch Cairn was situated; being more rugged and less cultivated, yet possessing much natural beauty. The mountain called *Ben Wyvis*, seen distinctly at Inverness, and all through the Avid, here raises its lofty summit amidst the crowd of lesser hills, and has been compared to a tremendous hay-rick, towering in the midst of a stack-yard. Though now the latter end of July, and the weather particularly warm, snow was still visible on its top. Jean remarked it, and asked her aunt if she ever remembered seeing the top of Ben Wyvis uncovered by snow.

"From the earliest periods of Scotch history, this hill has been remarked for retaining a large portion of its winter clothing, even through the warmest summers; but in the year 1826, in the month of September, it was said to be quite bare, which is

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considered a convincing proof that it was the warmest season upon record."

ELIZABETH. Such a cold, bleak spot can be of little value to any body; yet I suppose it owns a lord.

MRS. STEWART. To one family in this part of the country, its very property of being *always* covered with snow on the summit, renders it invaluable. You have seen Sir Hector Monro of Foulis?

ELIZABETH. Yes, aunt. But why, and to whom is it so invaluable?

MRS. STEWART. To Sir Hector Monro, because he holds his estate of Foulis in this county, (Rossshire,) by a tenure from one of the early Scottish kings, binding him to bring three waggon loads of snow from the top of that mountain, at any season of the year his majesty shall require it.

JEAN. But, dear aunt, what do you mean by a *tenure?*

MRS. STEWART. A *condition* by which an estate is held. In the early periods of British history, the barons received lands and estates from the king, on condition that they should attend him in battle; consequently, when the barons let their estates out to inferior persons, it was upon the same agreement; so that, whenever the king marched to war, all those barons and their tenants, who held lands upon condition of military service, were obliged to march with him, and this sort of bond was called the *feudal tenure*.

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ELIZABETH. I have read that the feudal system was established in England by William the Conqueror: was it at all known there before his time?

MRS. STEWART. Yes: in the time of the Saxons some traces of it are to be found, but it was not permanently settled till the Conquest; when William, to retain for ever the military authority in those hands which had enabled him to subdue the kingdom, divided all the lands of England, with very few exceptions, amongst the most considerable of his adventurers; and as none of the native English were admitted into the *first rank*, the few who retained their landed property, were glad to be received into the *second*, (who were denominated knights or vassals,) and to pay the same submission to the Norman barons as they did to their king. As civilization increased, this *military*, or *feudal tenure*, was found so burdensome, that it was changed for the performance of some other conditions, and sometimes into the payment of certain *fines*.

JEAN. What was the reason of the estate of Foulis being held by the delivery of a snow-ball?

MRS. STEWART. I have made many enquiries, but never received a satisfactory explanation. It would be very difficult to account for many of the tenures, while some are of such a nature that their origin can never be forgotten. For instance, the dukes of Marlborough hold the magnificent domain and palace of Blenheim, in Oxfordshire, by the honourable tenure of annually delivering, at Windsor

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Castle, a banner of France, consisting of gold fleur-de-lys upon a white ground, on the 2nd of August, in commemoration of the battle of Blenheim, gained by their ancestor, John Churchill, first duke of Marlborough, in the reign of Queen Anne. The Duke of Wellington, also, holds the estate of Strathfieldsay, in Hampshire, upon a similar tenure—that of delivering a banner at the castle, upon the anniversary of the battle of Waterloo. In our own history of Scotland, I can recollect one instance of the same kind of tenure, granted by James the Fifth, to a poor man; and if you like a *story*, I will relate such facts as I can call to mind.

JEAN. Do pray, dear aunt; for I am very fond of *true* stories, and this must be one of my kind.

ELIZABETH. And we shall have great pleasure in repeating it to Fanny and Emily, who are both remarkably fond of stories, and will be delighted with listening to one told us by you.

MRS. STEWART. It has been the custom with many crowned heads, in almost every country in Europe, to wander about their dominions disguised as private persons; in some cases for the laudable motive of hearing such complaints as might not otherwise have found their way to royal ears, and in others to enjoy such amusements as could not be partaken of by a monarch. Our kings, James the Fourth and Fifth, both had this habit, and many stories are told of the adventures they met with. The anecdote I am going to relate to you, happened to James the Fifth.

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JEAN. Was he not the father of the unfortunate Mary Stewart, Queen of Scotland, who was confined for eighteen years by Queen Elizabeth, and then beheaded in Fotheringay Castle?

MRS. STEWART. He was, my love; but this adventure happened long before her birth, which her unhappy father survived but a few days, dying when not thirty-one years old, of a broken heart. Now for my story. When James the Fifth travelled in disguise, he was called the *Goodman of Ballengiech*, a name known only to a few of his principal nobility and attendants. Upon one occasion, being alone and disguised, the king fell into a quarrel with some gipsies, and was assaulted by four or five of them, near the bridge of Cramond, on which the king got; and as it was high and narrow, he was enabled to defend himself against those who attacked him. A poor man, who was thrashing corn in a neighbouring barn, being attracted to the spot by the noise of the scuffle, and seeing one man defending himself against many, came with his flail to the king's assistance, and fought so gallantly, that the gipsies were soon obliged to fly. The husbandman, whose name was John Howieson, then took the king into the barn, brought him water and towel to wash the blood from his face and hands, and then walked with him a little way towards Edinburgh, for fear he should be again attacked. James then asked the poor man if there was any wish in the world which he would particularly desire should be gratified; for,

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in gratitude for the service he had just rendered him, he would endeavour to oblige him, let it be what it might. John Howieson, who was a bondsman on the farm of Braehead, near Cramond, belonging to the king, confessed that he had always wished to be proprietor of the farm on which he laboured, but greatly feared it was not in the power of his new acquaintance to obtain it for him. James answered, that as the Goodman of Ballengiech, he had a small appointment about the palace, and that he would do the best he could to repay his manful assistance, and begged he would come to see him at Holyrood Palace in a few days. John Howieson returned to his work; but on the following Sunday he went to the palace, saw his new acquaintance, who discovered himself to be the king, and made the astonished countryman a present of the farm of Braehead, on condition that he, or his successors, should be ready to present *an ewer and basin* for the king to wash his hands, when his majesty should come to Holyrood Palace, or should pass the bridge of Cramond.

JEAN. That was a very proper service for him to perform to his liege lord, because it preserved the remembrance of the circumstance for which he obtained the estate. Did any subsequent king ever require him or his descendants to fulfil this condition?

MRS. STEWART. In 1822, when his present majesty, George the Fourth, came to Scotland, the de-

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scendant of John Howieson, of Braehead, who still possesses the estate bestowed by James the Fifth upon his ancestor, appeared at a solemn festival, and offered his majesty water from a silver ewer, that he might perform the service by which he held his lands.

ELIZABETH. From what did the king take his name of Ballengiech?

MRS. STEWART. From a steep pass, which is so called, leading down behind the castle of Stirling.

JEAN. Where is Cramond Bridge? I never heard of it before.

MRS. STEWART. Cramond is about six miles from Edinburgh, and is situated partly in Edinburghshire, or *Mid Lothian*, and partly in Linlithgowshire, or *West Lothian*, and is now noted for its extensive iron manufactory. Cramond Water, or the Almond, over which was the bridge on which the king fought, is a small but pretty river, its branches very fertile, and now adorned with villages and country seats.

JEAN. Is Cramond a large town? I must look in the map of Scotland for it.

MRS. STEWART. The parish of Cramond consists of two villages, called *Over* and *Nether* Cramond. The latter is situated at the influx of the river Almond into the Forth, and is deserving of notice as having been once a famous naval station of the Romans, and was called by them *Alaterva*. Three Roman roads meet at Nether Cramond, and there are the remains of a Roman bath. Many altars,

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medals, and various other antiquities have been dug up, which are considered convincing proofs of its having been a Roman station.

ELIZABETH. What a wonderful people the Romans were! I should like to travel through my native land, and see all the celebrated places they visited, and the innumerable curiosities it seems to contain. Do you think, aunt, my wish is ever likely to be gratified?

MRS. STEWART. A little reflection, my Elizabeth, will convince you that I cannot give you an answer to that question; for how can I tell where your future lot in life may be cast? The wish to travel is very natural to young people; but that your journeys may be of any use to you, beyond the mere gratification of the moment, you must apply most sedulously to the cultivation of your mind, that should an opportunity offer, you may be prepared to avail yourself of it, and derive all the *benefit* as well as *amusement* from such a pleasurable excursion.

JEAN. What I *see* I seldom or never forget; what I *read of* very often slips out of my recollection; therefore I think, aunt, travelling must be the sure road to improvement. I shall never forget what you have told me about Ben Wyvis, because I have seen the mountain; and your explanation of *tenures* will likewise remain, because it is connected with it.

MRS. STEWART. By accustoming yourself to fix your whole attention upon whatever subject you are reading, you will succeed in making it so far your

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own, as to keep it in your recollection: if you take up the false idea that you must necessarily forget what you read, your thoughts will be wandering, and you will be nothing either the better or the wiser for your studies. It falls to the lot of few, comparatively, to travel far and see distant climes, or even to explore the beauties and wonders of their country; therefore, if your head possesses no more valuable properties than the sieve-like one of letting all run out as fast as it is poured in, I fear, my dear Jane, you will be an ignoramus, for I do not imagine your travels will ever be very great.

JEAN. Oh! dear aunt, I do not mean that I can recollect nothing but what I see; I mean, that seeing a thing, or place, makes it more easily remembered.

They now reached a little straggling village, and turning into a cottage on the right hand, Mrs. Stewart opened a door, out of which rushed a pig, followed by a numerous bevy of cocks and hens; these they allowed to pass before they attempted an entry. The first apartment they went into was a sort of stable, in which reposed a cow and her calf; she then opened a door on the left hand, from which issued such a cloud of smoke from the peat fire, as entirely prevented them from distinguishing any of the human habitants of the cottage; but hearing a cough om the inner room, Mrs. Stewart gently lifted the atch of the door and went in. A delicate looking ung woman was seated in a comfortable arm chair.

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nursing a little baby, and who seemed much distressed by the smoke from the adjoining room, which made her cough very much. She and the child were both very neat and clean, and the bedroom in which she was seated was extremely tidy, and had a much greater appearance of comfort than could have been expected from the disorder of the outer apartment.

"How are you this morning, Kate?" enquired Mrs. Stewart, in a voice of much kindness.

The young woman attempted to rise, but was prevented by Mrs. Stewart, who seeing the child was asleep, would not allow her to move, lest she should disturb it.

"Sit still, Kate, I beg," said Mrs. Stewart; "I hope you feel better, for you are looking so."

"Many thanks, ma'am, for all your kindness. I am indeed better, and so is my dear bairn. See how sweetly it is sleeping! But for the care you have taken of us both, the little thing would now be sleeping its last.

It was a pretty little fair infant, not very fat, (for, as its mother's words implied, it was but just recovering from one of the many maladies to which infants are liable,) but its skin was so transparent, that every small blue vein might be traced, which, with the tranquillity of its little features, made it look like a beautiful piece of statuary.

"I think, Kate, it is gaining a little flesh now. I almost fancy it fatter than when I last saw it, though

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that is not above three days ago. Does it still continue to like the panada I sent it?"

"Oh, yes, ma'am, indeed it does, it takes it very kindly; and I have at last persuaded my mother to let me have a little cream for it, morning and evening; but she is very unwilling to give it me, for she is afraid it will hurt the bairn."

"For so delicate a child milk is too heavy; and as you are not able to nurse it yourself, the best substitute is a little cream and water. Where is your mother, and what occasions so much smoke in the other room?"

"Mother is going to bake some oatcakes, by and by, so she made up the fire before she went out, that it might be ready to put the girdle on when she comes back. The smoke makes its way every where, and is very disagreeable; but I am more used to it now, and am better able to bear it.

ELIZABETH. Were you not always used to it?"

KATE. No, Miss; I was foster sister to Miss M'Innoch, and when we were about two years old, she was fetched home; but as she was not happy without me, I was fetched too, and I lived with her till she married and went abroad, (it will be two years next Hallowe'en;) then I married Duncan, and we were so happy till the fire took our little cottage, and burnt it to the gronnd, just after my little baby was born. I then came to live with my mother till Duncan can build up our house again; but I and the bairn have been very ill ever since the fire, from the

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cold we got then; and had it not been for Madam I do not know what would have become of us. It is she who lent me this nice chair, and who has found us in meat and clothing, for we lost our all at the fire; and my father and mother are but poor people, and have other younger children than I to take care of; but Duncan is a good honest lad, and he will work early and late to get me a home of my own. He says it shall be very snug, and as pretty a cottage as any in the Highlands.

JEAN. Has he begun to build it yet?

KATE. Oh yes, Miss. He, his father, and brother work at it all their spare hours; for Duncan is not an idle lad: and it is to have a chimney in it—a proper chimney, not merely a hole to let the smoke out, but a real chimney and a fire-place, so that it will be more comfortable than it even was before.

JEAN. But shall you burn coals or peat? I would have coals if I were you, Kate, they are so much better than peat, and make a nicer fire.

KATE. Yes, Miss, so they do; but you know we are only poor people, and cannot have every thing as you gentlefolks do. We cotters never think of such things as sea-coal; we all use peat, and it makes a very good, cheerful fire; and as I shall have a chimney, there will never be the smother in my house that poor mother has in hers. But she does not mind it.

ELIZABETH. I suppose then, your mother has always been used to the smoke, as you say she does not mind it.

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KATE. All her life, Miss; for she never went to service at all, but staid at home with grandfather and grandmother till she married; and though they were very well to do, yet they never had a chimney, for such things were not known here then."

The old woman's voice was now heard. She was talking very loud to a girl who was crying. She soon opened her daughter's door, and was going to detail the cause of her anger; but seeing the ladies there, she again shut it and was silent. Mrs. Stewart followed her, and enquired what was the matter.

OLD WOMAN. Why, ma'am, I left this girl with strict charges to attend to the fire, and get the girdle hot against I came home; but no sooner was I gone than she ran off, and thought no more of the fire or girdle.

MRS. STEWART. Indeed, Elsie, this is a serious act of disobedience to your mother's orders. I am very sorry to hear it, for as you are growing a great girl, you should do all in your power to assist her. You will never be a favourite of mine till you become obedient and industrious. Now attend to the fire, and put on the girdle, while I speak to your mother; but we must go into the air, Maggie, for the smoke affects my chest so.

Elsie had ceased crying when Mrs. Stewart made her appearance, and had stood upon one leg, leaning against the door post, with her finger in her mouth, while that lady spoke to her; and when desired by her to put on the girdle, she slowly, and with a very ill will prepared to obey. She was not naturally an ill-

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tempered girl; but the improper indulgence she had always met with had made her self-willed and selfish. But, like too many Highland mothers, Maggie never perceived how much she injured her children by this injudicious fondness; nor did she ever allow them to be in the wrong, except when their idleness and disobedience was attended with some little inconvenience to herself, (as in the present instance,) and then she thought she sufficiently fulfilled her maternal duties by quarrelling with them, and threatening them what she would do if they did not mend. Mrs. Stewart had frequently endeavoured to persuade her to make her children more cleanly and industrious; but the truly Scotch reply of, "I canna be fash'd," (only expressed in Gaelic,) was what she mostly got for her kind interference.

When Mrs. Stewart and Maggie came in, they found the fire burnt quite clear, and the girdle (a round plate of iron, on which oat cakes and barley bannocks are baked) quite warm and ready for the paste. Mrs. Stewart then called her nieces, and taking leave of Kate, her mother, and Elsie, they walked on to another cottage, much neater and cleaner looking than the last. It had a neat little bit of ground, the centre serving as a *kail-yard*, and the borders around were gay with all sorts of flowers. At the door was seated a clean, healthy looking woman spinning, and some little children were playing about very happily, without either shoes or stockings.

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"Oh, dear aunt!" exclaimed Jean, "this cottage is as neat and as gay looking as the Pierce's. How much more comfortable it looks than Maggie Barron's! The midden and peat-stack are not in front of the house, as in most of the others."

"No, my dear; a very decent, industrious couple live here. The woman was once my servant, and the man now looks after my farming concerns. By my advice they have arranged their little dwelling more tidily than many of their neighbours, who cannot be persuaded to live otherwise than their fathers did before them; and, as you must have observed on your papa's estate, the usual rule is, to place the *midden*, or *manure-bed* just before their windows, so that, in wet weather, the moisture from it frequently runs into a little pool close to the door, into which they are in danger of stepping every time they go in and out. This, which to us would be a great annoyance, is very little or none to them; for as they are bare-footed, they have no shoes to wet and spoil, and they are not particular with respect to where they tread. But this carelessness about the decencies and comforts of life is very much wearing off, and I have no doubt a very few years will make a great alteration in their habits, in some respects, for the better."

As they walked up the neat little garden to the door, the good woman left off spinning, and rose to receive her visitors; the little children running to their mother and clinging to her clean, tidy checked

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apron, hid their faces, as is the usual custom with little rustics in all countries.

"You are very busily employed I see, Janet," said Mrs. Stewart, so soon as they reached the house.

"Oh yes, ma'am," answered Janet, dropping a curtsy: "these are not times for the like of me to be idle. My bairns are such strong things, and they require so much meat and clothing, that both their father and I must work hard to supply them, bless their little hearts! Ah! Miss," she continued, looking at Elizabeth, "how you are grown since I used to nurse you, when I lived at Balloch Gowan with Madam; you were then a little wee bittuck, but always a sweet-tempered bairn, as I often tell my Rory there, who is a wee bit troublesome sometimes."

"Indeed, Janet," said Elizabeth, "I have not forgotten your early kindness to me when, as a little girl, I used to visit my aunt. I have a small present for you of some tea and sugar, at home, which I will send you; and also some gingerbread for your children, which I should have brought with me, but I did not know you lived this way. When I was last here you lived by the kirk, (church,) and I knew we were not going there."

JANET. No, bless you, Miss! we have been gone from there a year next Hallowe'en. Many thanks to you for your thinking of us, and to Madam M'Ivor for sending such good things.

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"No, Janet," interrupted Mrs. Stewart; "my sister did not send you the tea and sugar, Elizabeth has bought it out of her own little allowance; for her kind mamma has taught her, that the most satisfactory way of spending her money, is in purchasing little presents for those to whose kindness she is indebted, and not in selfishly lavishing it on little luxuries and indulgencies for her own private gratification."

JANET. Ah! ma'am, she is the good child of a good mother, and may God bless them both.

"As my nieces do not leave me for some days," said Mrs. Stewart, "you and the children must come to Balloch Gowan to-morrow, and dine and spend the day, and then you shall have your tea and sugar, and the children their gingerbread."

To this proposal Janet gladly assented; and after some further conversation upon the state of her family affairs, they took leave of Janet and her children, and walked home, where they had the happinees of meeting Mr. M'Ivor, who had been still further to the North upon some business. He proposed returning to Inch Cairn the next day; but Mrs. Stewart easily prevailed on him to remain a few days quietly with her, as it was not very often that he visited her.

Janet and her family paid their promised visit, and spent a very happy day. The young people left their kind aunt the beginning of the following week, and a few days after their return to Inch Cairn, they

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had the inexpressible pleasure of again seeing their beloved brother, with the happy prospect of his spending six or seven weeks with them; during which time Miss Angerstein had kindly promised to relax a little from the usual routine of study, that they might enjoy each other's society.

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CHAPTER II.

ELIZABETH and Jean had great pleasure in relating the events of their pleasant excursion to their sisters, and did not forget to tell Emily and Fanny the story of King James the Fifth; nor, though they had not seen their brother for so long a time, did they omit paying the accustomed attentions to their grandmamma, and amused the good old lady greatly by their accounts of all that had passed. Alexander was delighted to find so much harmony among his sisters, (for he tenderly loved them all,) and was not long in discovering how much was owing to Miss Angerstein's judicious management, aided and supported in her authority by Mrs. M'Ivor's confidence and esteem. He now had great pleasure in joining them during their hours of recreation; and as Miss Angerstein thought they would have much to relate and to hear on both sides, she left them to themselves before breakfast, promising, that as air and exercise was absolutely necessary for their health, the time should be passed in the gardens and shrubberies, and not in the house.

She was one morning walking in the avenue of

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plane and chestnut trees, the young people were enjoying a game at trap-ball on the lawn, and for some time their amusement was pursued with the greatest eagerness; but they got heated, and were obliged to give it up. They then walked about, chatting and laughing, highly diverted with some of Alexander's school exploits. They had many questions to ask; and as this was his first *half* at Eton, every thing still wore an air of comparative novelty to him, and he was delighted to have a set of admiring auditors to describe things to. He had in vain endeavoured to make them understand, by *description*, the relative situations of the school-yard and the cloisters, and was therefore under the necessity of having recourse to his pencil, and made a hasty plan of the outer quadrangle, on the south of which is situated the college chapel, on the west the upper school, on the north the lower school, with the sleeping apartments for the boys on the foundation; and on the front, or east end, is part of the provost's lodge, with a beautiful ancient tower and arched gateway, leading to the inner quadrangle, or cloisters. From this they easily understood what he meant; but Jean wanted him to give her a *little sketch* of the gateway and tower he described as being so beautiful; but he declined doing so till he got a better pencil than the one she had furnished him with.

"Why, my dear Alexander," said Jean, coaxingly, "it is a very nice pencil, made of the very best lead."

"I dare say it is, Jean, for it very much resembles

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a *plummet*, which is really made of lead; but the best pencils are not."

"Not made of lead, Alexander! Now you are laughing at me. Why we all know that *black-lead* pencils are made of lead. There are *slate* pencils and *chalk* pencils; but surely you do not mean them."

"No, Jean. I mean, that though these pencils are called *lead* pencils, they have not a particle of lead in them."

JEAN. I will ask Miss Angerstein; for indeed, Alexander, I cannot believe it. I think you are making a joke of me; because you know I am not so wise as you are, you are trying to make me believe this nonsense.

ALEXANDER. Now, Elizabeth, am I not speaking the truth? Do not you know that these pencils are *not* made of lead?

ELIZABETH. I am sure, Alexander, you would not willingly mislead; but I have always considered them as black-lead pencils, and cannot say whether they are or are not made of lead.

ALEXANDER. How provoking! Why, my Liz, I did expect better things from you! Well, now I have nothing else than to appeal to your oracle, Miss Angerstein, (whom, by the bye, I like very well;) and so let us run and ask her whether or no I am right.

And away they all flew into the avenue, to have the important point decided. When arrived there

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they were so out of breath with their race, they could scarcely speak; yet they all endeavoured to express their various feelings of surprise, doubt, and enquiry, though to so little purpose, that, amused at each other's failure, there was an instantaneous burst of laughter, which totally prevented all questions for some minutes; at last, Emily having recovered strength to speak, she exclaimed:

"Dear Miss Angerstein, Alexander has been learning such nonsense at Eton! He says, black-lead pencils are not made of lead."

"And I am quite certain," said Jean, "that they *are* made of lead, or you would have told us so before."

Miss Angerstein looked gravely at Jean, and said, mildly, "you must not be too positive, Jean, for I think you will find yourself in the wrong. But as yet I have not heard what has occasioned the pleasure of this very joyous visit."

"I cannot make my sisters believe but what this is a *lead* pencil. It is not, is it now?" said Alexander.

Miss Angerstein. So far as my knowledge extends, I must agree with you, Alexander, and say, that *no lead* enters into its composition.

Alexander was in such transports, that he jumped about, clapping his hands with delight, exclaiming: "There Jean, there Elizabeth, did I not tell you it was *not* a *lead* pencil!"

Miss Angerstein. Jean is unfortunately too much inclined to support her own opinion most

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vehemently; but I have the greatest hopes she will correct herself of this fault. Elizabeth, I hope, has not given way to it.

"Oh! no, no, no!" exclaimed all the young people at once.

"No, indeed!" said Alexander, "I was only surprised Elizabeth did not know such a simple fact."

"It certainly may now appear a *simple fact* to you, Alexander; but if you look a little way back in your long life, I dare say you may recollect the time when even you were ignorant of it," said Miss Angerstein.

"That I do: I first learnt it about two years ago, when I attended some lectures, and my father afterwards explained it to me."

Miss Angerstein. Then do not be so much surprised at your sister's ignorance of this *simple fact*. They have never attended any lectures, and as yet know nothing of mineralogy; but by the time they are of your age they may perhaps have learnt of what sort of mineral these pencils are made, with some *simple facts* of equal importance.

Elizabeth. Will you not tell us, now, what the mineral is called?

Miss Angerstein. I think we will apply to your brother for this piece of information. Come, Alexander, tell your sisters what pencils *are* made of, as you have begun by telling them what they are *not* made of.

Alexander. I can easily tell them *the name* of

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the mineral; but I am by no means so sure that I can tell them *what* that mineral is.

EMILY. Tell us the name then, dear Alexander.

ALEXANDER. *Plumbago* is its name: the metallic substance which principally enters into its composition, papa told me, is iron.

JEAN. Iron! What! black-lead pencils made of iron! Is that true, ma'am?

MISS ANGERSTEIN. Your brother did not say they were *made* of iron, my dear; he merely said, that iron was the only metallic substance that entered into their composition.

ELIZABETH. I do not understand what plumbago is: I should wish to have it explained, for I am quite in a puzzle.

JEAN. But is this plumbago made by men, as you talk of its composition? Do tell me, Alexander, what there is besides iron.

ALEXANDER. The other ingredient is *carbon;* and plumbago is dug out of the earth. Now do not ask me what carbon is, for I have forgotten myself.

ELIZABETH. Then I must ask my dear Miss Angerstein for a little clearer explanation of this matter, as you are come to the end of your knowledge on the subject; for you have deprived us of black lead, and given us nothing satisfactory in its place.

ALEXANDER. I have done the best I can, Elizabeth. I tell you the pencils are made of plumbago, a mineral substance formed of carbon and iron, which is dug out of the earth. More than this I know not.

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ELIZABETH. I do not feel quite satisfied even with this explanation, for I do not know what carbon is.

MISS ANGERSTEIN. Carbon is nothing more than *charcoal* in a state of perfect purity; for charcoal, after being freed from its earthy and saline particles, is called carbon: it enters into the composition of several minerals, and of all vegetable and animal bodies.

Elizabeth, in a tone of despair, exclaimed, "How very ignorant I am! and how much I have to learn before I shall be a rational companion for sensible and well-informed people!"

MISS ANGERSTEIN. Do not frighten yourself, my love; for if you are aware of your own deficiency, that is the first step to improvement. It then depends upon your own exertion to apply the remedy, and I am both ready and willing to give you every assistance in my power.

JEAN. When Alexander leaves us, then we shall take our usual morning walks, and you promised to continue the explanation of the three kingdoms, and that will partly remove Elizabeth's cause of sorrow.

MISS ANGERSTEIN. By that time, my dear, the autumnal mornings will, I fear, be too damp and cold to allow of our walking before breakfast, so we must defer them till the next year, and improve as much as we can in other things.

ALEXANDER. Elizabeth has shown me her common-place book, part of which I have read; and if

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you would admit me among the number of your young companions in these morning walks, I should instantly vote for their beginning to-morrow, because I have also much to learn; and another powerful motive is, I think I should be amused. But if you do not feel inclined to be troubled with me, why I must vote for their being deferred for some time.

Miss Angerstein. I have not the slightest objection to your forming one of the party. My motive for discontinuing the walks and conversations was, that you and your sisters might enjoy yourselves in your own way. If you really wish to continue them, we will, as you say, begin to-morrow. What do you think of this plan, my dears?

Elizabeth and Jean were delighted with it; but Emily and Fanny seemed to prefer the games of play they had enjoyed for some mornings. But when Miss Angerstein suggested that they should remain with the nurse, and play with the younger ones, they begged to be admitted into the walking party; and that when Miss Angerstein told any amusing story, she would be so good as to let them hear it. Things being thus amicably settled, the next point was, which of the two remaining kingdoms should be the subject of their conversations. Jean voted for *botany;* but as Alexander's wishes did not seem to incline so much towards the *vegetable* as the *mineral* kingdom, it was agreed that *mineralogy* should claim their attention on the morrow.

Elizabeth. But will you not now tell us a little more about plumbago? Where is it found?

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Miss Angerstein. In Great Britain, Germany, Spain, France, America, and at the Cape of Good Hope. That of England is the best, having the finest grain.

Alexander. Where in Great Britain?

Miss Angerstein. At Borrowdale, in Cumberland; and at Craigman, near New Cumnock, in Ayrshire, Scotland; but the Scotch is inferior to the English. The vein of plumbago lies between strata of slate, and is from eight to nine feet thick in the Borrowdale mine, which is not opened more than once in three or four years, the quantity thus obtained being fully sufficient for the demand.

Emily. How is it put into the wooden cases of the pencils? Is it melted and run into them?

Miss Angerstein. No, my love, not the best pencils; the mineral, which is found in kidney-shaped lumps of various sizes, is sawed into slender square pieces; grooves of the same shape and size are cut in cedar, or some other soft wood, into which the mineral is fixed, another piece of wood is glued upon this, and the whole is then worked into a circular form; and the finest kinds of black-lead are prepared for use by being boiled in oil before they are cut. The coarse kinds, and the refuse of the sawings, are melted with sulphur, and then cast into coarser pencils for carpenters, which kind may in general be easily distinguished by their sulphureous smell.

Jean. Why is cedar used always for the cases of pencils?

Miss Angerstein. It is a soft wood and easily

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worked; besides, it resists the attacks of insects, on account of its powerful fragrance, and this is a great recommendation.

ALEXANDER. The screw of my mahogany reading-desk would not act easily, and upon asking Macpherson what I should do with it, he took it from me, and rubbed the inside with black-lead: was that plumbago?

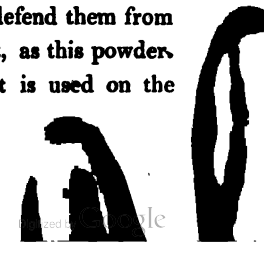
MISS ANGERSTEIN. Yes: the powder which is produced in the sawing of pencils is employed for such purposes, and is said to be far superior either to grease or soap. I understand it is very advantageously applied to any wood-work subject to friction, such as the inner surface of wooden screws, to packing presses, slides, and the axles of various sorts of machines.

EMILY. What is the black-lead with which I have seen Kate clean the grate in the nursery?

MISS ANGERSTEIN. The same powder I have just been speaking of.

FANNY. Why do they use it to clean grates? I should think it was too valuable to be so thrown away.

MISS ANGERSTEIN. So much powder must be made by sawing the lead into shape, that there will always be abundance for every use we can apply it to. Nothing else will give so bright a gloss to cast-iron grates and stoves, or so well defend them from the action of the fire, or from rust, as this powder. There is one purpose for which it is used on the



Continent, which I think you would never guess at, Elizabeth.

JEAN. Oh! then pray tell us at once, for if Elizabeth cannot guess it, we giddy ones have no chance.

MISS ANGERSTEIN. For blackening the human hair, when, through age or illness, the colour changes.

ALEXANDER. What dirty creatures foreigners must be, to use it for such purposes!

MISS ANGERSTEIN. I do not defend the practice, my dear boy; but I do wish you would not be so ready to censure harshly; for were we to look at home, we might discover many practices even more repugnant to health and cleanliness than this. What think you of the different uses of tobacco and snuff? What mouth can be sweet into which the fumes of that nauseous weed enter? or what fingers can be clean, which have snuff constantly between them?

ALEXANDER. None: nor can any head be clean that has black lead rubbed into the hair; and I think grey, or even fiery red hair would be preferable to such a dirty remedy.

MISS ANGERSTEIN. In that I agree with you; so I conclude that neither you nor I shall adopt this plan of improving our personal appearance.

ELIZABETH. Is there no other use to which this powder is applied? nothing else you can tell us about plumbago?

MISS ANGERSTEIN. I do not at the moment re-

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collect any thing else, my dear, except that razor-strop makers occasionally employ black-lead in the composition which they spread upon leather, for the sharpening of razors, pen-knives, &c. But we must go in now, and prepare for breakfast, which is very fortunate, considering that I have quite exhausted my small stock of information.

ALEXANDER. But to-morrow morning, Miss Angerstein.

MISS ANGERSTEIN. To-morrow morning, if you are so inclined, we will begin a short explanation of the interesting science of mineralogy. In the mean time I must refresh my own memory a little, that I may be enabled to answer such questions as you may choose to puzzle me with; and I must beg you to bring a stock of patience with you, that if you do not find the beginning so interesting as you could wish, it may assist you in getting over some of the rough and dry roads which me may have to travel together.

EMILY. But you will make it very entertaining with pretty stories and descriptions.

MISS ANGERSTEIN. I will do the best I can, my dears; but you must not be too sanguine in your expectations, lest you should be disappointed.

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CHAPTER III.

ALEXANDER was one of the first ready for the morning walk, and when Miss Angerstein and her young companions reached the cow-house, they found him there busily engaged in getting their glasses of milk ready for them.

" I was so anxious that no time should be lost this morning," said Alexander, when the party appeared, " that I have got all your glasses milked aginst you arrived, except Miss Angerstein's, and Madge is now milking it from Cherry."

" Oh, fie, Alexander!" said Fanny, " you should have got dear Miss Angerstein's ready first. She shall have mine."

ALEXANDER. Indeed, Fanny, I did not mean any inattention to Miss Angerstein, for I had hers milked last that it might keep warm till she came.

Fanny was fully satisfied with this explanation, and Miss Angerstein having thanked the good-humoured boy for his attention, the happy little party drank their milk, and leaving the cow-house, took the way to the Burn side, that being now a very favourite walk. Alexander offered his arm to Miss

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Angerstein, and Elizabeth being already on the other side, Jean found herself excluded from her usual place when walking, and a cloud seemed gathering on her brow. Her instructress, who was never unobservant of any thing that passed, though she did not always think it judicious to notice every shadow of temper, continued to walk on, chatting with those who would answer her, of whom Jean was not one. Just as they had passed the rustic bridge, and Alexander stepped back to fasten the gate, Jean rushed forward and very rudely seized Miss Angerstein's arm: "There, sir," she said, "you may now go and walk with the young ones."

"Well, Jean," said Alexander, mildly, "that is neither civil nor kind; had you told me you wished to take hold of Miss Angerstein's arm, I should not have objected, but would have given up to you directly."

"You took my place, sir; and you had no business to do so."

"Jean," said Miss Angerstein, taking her arm away, "I am much surprised at your forgetting yourself so sadly. What is all this temper for? and why did you place your arm so rudely within mine?"

"Because Alexander would not let me walk with you, which I always did when we were talking about the animal kingdom; and now he is turning me away to walk with the young ones."

"No, my dear; your brother did not intend to prevent your being one of our party, but it was your

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own unfortunate temper, from which you had loosened the check which you have of late kept over it. Now is the time to struggle against it, my little girl, and to regain that self-command which I trust is only lost for a moment."

"Then Alexander is to have his own way entirely! Yesterday I wanted you to explain the vegetable kindom to us, but because *he* did not like it, you changed it to the mineral kingdom; and now he is to have my place."

"It is only your place, Jean, when you behave well; when you are fretful and peevish, as you feel at this moment, I cannot admit you as my companion in any way. It should be a sister's endeavour to make her brother's visits at home the happiest periods of his life; and instead of being angry at my willingness to comply with Alexander's wishes, you ought to feel gratified that you have it in your power to oblige him, and give up all your own inclinations when they interfere with his enjoyments."

ALEXANDER. You will forgive her this once, I hope; for I see by her countenance she is sorry for having given way to this slight return of ill-humour. Are you not, dear Jean?

Jean did not immediately answer, temper still striving hard for the mastery: a silence of a few minutes ensued. At length she burst into tears, and turning to her brother, said, in a voice scarcely audible from the struggle within: "I am indeed very sorry, Alexander, and I beg you and Miss An-

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gerstein to forgive me, and I will walk where you please."

"My dear child," said her kind instructress, "I heartily forgive you, as I am sure your brother does; and though I regret you should have been so far off your guard, as to behave unkindly to your brother and rudely to me, yet I congratulate you upon the victory you have gained over your besetting sin; for a *good temper* is one of the principal ingredients of happiness; and an *ill temper* makes not only yourself miserable, but all those with whom you are connected. Had you persevered in the perverse temper in which you left the cow-house, none of us could have had any enjoyment of our morning walk."

JEAN. But people cannot be always good-tempered, without it is born with them.

MISS ANGERSTEIN. On many occasions we may feel inclined to be otherwise; but a little timely precaution will check, and a constant habit of self-control will in time prevent, these risings of temper. It is very seldom that good temper is born with us; yet that is no excuse for our not possessing it, for it may be acquired. Almost every object that attracts our notice, every circumstance that occurs, has a bright and a dark side. If we accustom ourselves to look at the displeasing side, we shall sour our dispositions, and consequently impair our happiness; but if we take the bright side, our tempers will be insensibly softened, and we shall not only improve

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our own happiness, but also that of every one about us."

JEAN. What do you mean by the bright and dark side of a circumstance?

MISS ANGERSTEIN. Shall I explain it from what has just occurred? I think you will the better understand it, if I do.

Jean blushed very deeply, and said, in a voice of great humility, "If you please, ma'am."

MISS ANGERSTEIN. When Alexander took your place this morning, if you had good-humouredly said to yourself, "As I find much pleasure in walking there, I suppose my brother will do the same; and it is a good opportunity for me to practice a little self-denial, by giving up my wishes with cheerfulness, that he may share in them. I can hear very well if I walk either by him or Elizabeth; and if I do not, I know they will be so kind as to repeat it to me. It is so pleasant to have our dear brother with us again! and when he is gone to school I can again walk with my governess." This is the *bright* side. The *dark* one, I think, I need not describe.

JEAN, *(sighing.)* I wish I had done so! but it is too late now. I hope I shall recollect for the future which side I ought to look at: yet it is so difficult to think of such things.

MISS ANGERSTEIN. I have no doubt, Jean, but you will profit from this morning's error, and that the difficulty of repressing your rising ill-humour will not prove so great as you imagine. You have

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already achieved great things, for you are more inclined to oblige others than you formerly were: persevere only, and all will yet be well.

"Now, dear Jane," said Alexander, "as we all understand each other, "you shall return to your own place, if Miss Angerstein will allow you, and I hope we shall hear something to amuse us about stones."

"No," said Miss Angerstein, "that would be treating her as a nurse does a baby: Jean is certain of my forgiveness, but her own good sense will tell her she ought not to accept your offer. She will walk by Elizabeth, and we will now change the conversation. What do you understand by *mineralogy*, Alexander?"

ALEXANDER. It is very hard to come upon me for the first question: I, who am only a novice in this sort of concern. Yet I must do my best to answer the lady-president of this august society, and will therefore say that I imagine it to be a description of earths and stones, and such things, which are called minerals.

MISS ANGERSTEIN. I believe it is generally explained to be the *art of distinguisking mineral substances from each other.*

ELIZABETH. I have not a clear idea of what may be called *minerals.* Will you be so good as to explain them to me? for one day, when I was looking at an indescribable lump of something in my aunt's collection of curiosities, I called it a *mine-*

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ral; but a gentleman standing by, said it was a *fossil.*

Miss Angerstein. All the substances which form the ground and earth are called minerals, because all are believed to contain some portion of metal; all bodies found in or on the earth, and not of *vegetable* or *animal* origin, are called minerals.

Jean. What did the gentleman mean by its being not a *mineral,* but a *fossil?*

Miss Angerstein. Because the word *mineral,* though literally meaning any thing dug out of a *mine,* is now chiefly confined to *metallic* substances; and the word *fossil,* which originally meant the same, (for all metals are, properly speaking, *fossils,*) is now used only for *stony matters.* I conclude, therefore, that the "indescribable lump of something," which your sister was looking at, must have been *stone* and not *metal.*

Alexander. Then a short explanation of a mineral is—any thing dug out of a mine?

Miss Angerstein. Yes; and mineralogy is the art of distinguishing, and the mode of describing them, so as to recognize them with facility whenever they are met with.

Alexander. Very easy, so far. But I dread the long lists of classes, which will be forthcoming presently. Don't you, Elizabeth?

Elizabeth. No. I did when we first began our conversations upon zoology; but every thing was made so plain and easy to us then, that I

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greatly hope it will be the same now. Besides, to you, who are learning the *dead languages*, (as you were boasting of yesterday,) a few names which appear unintelligible to us ignorant girls, will only awaken dormant ideas, and be as familiar as the alphabet is to us.

ALEXANDER. Now then, Miss Angerstein, let us go forwards, if you please, and learn a little of their classification. Whose system is now most used, the Linnæan or the Wernerian? for I have heard of both.

MISS ANGERSTEIN. The Wernerian is now chiefly followed in all the nations of Europe; and is said to be the clearest, at the same time that it is the simplest arrangement.

JEAN. The Linnæan derives its name from the great Swedish naturalist, to whom you introduced us when speaking of the animal kingdom; but from whom does the Wernerian take its title?

MISS ANGERSTEIN. From *Werner*, the celebrated professor of mineralogy at Freyberg, in Saxony. Linnæus divided the mineral kingdom into *three classes* only, but Werner into *four*.

ELIZABETH. Was Linnæus the first person who arranged minerals into classes, &c.?

MISS ANGERSTEIN. There were writers upon minerals long before the Christian era. Theophrastus, a native of Eresus, in Lesbos, wrote a history of stones, which has been translated into English. Dioscorides, (who is said by some to have been

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physician to Anthony and Cleopatra, and by others to have lived in the time of Nero,) described a few mineral bodies. He was a native of Cilicia, in Asia Minor, and originally a soldier, but afterwards applied himself to study: his works are, however, mostly upon the medical virtues of plants. Pliny the Elder, who lived under the Emperor Vespasian, wrote thirty-seven works upon Natural History, in which he treats of *minerals*, as well as of the *stars*, the *heavens*, *wind*, *rain*, *hail*, *trees*, *flowers*, and *plants;* besides an account of all living *animals*, *birds*, *fishes*, and *beasts;* a geographical description of every place on the globe then known; and a history of every art and science, of commerce and navigation, with their rise, progress, and several improvements.

JEAN. What an indefatigable old gentleman! Did he kill himself by over study? for I have heard of such things.

MISS ANGERSTEIN. Not exactly, my dear, though he met with his death through his love of science; for being at Misenum, (where he commanded the fleet,) A. D. 79, when the first eruption which is recorded of Mount Vesuvius took place, his desire to become acquainted with the operations of nature induced him to approach the mountain, where, before he could effect his escape, he was suffocated by the thick vapour that surrounded him: his body was not found for three days.

ELIZABETH. Poor man! his love of science did

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indeed cost him dearly. Was it Pliny the Elder, or his nephew, Pliny the Younger, who wrote those letters, some of which you have allowed me to read?

Miss Angerstein. Pliny the Younger, the adopted son of the one of whom we have been speaking. When he was appointed by the Emperor Trajan proconsul over Pontus and Bithynia, he put a stop to the persecutions which had been begun against the Christians of his province, and declared to the emperor that the followers of Christ were a meek and an inoffensive set of men.

Alexander. I always understood that Pliny lost his life in the reign of Titus, but I think you said under Vespasian.

Miss Angerstein. I did not say so. However, it is differently represented by different authors; but all agree in placing it in the year after Christ, 79, which was the year Vespasian died, and Titus came to the throne: therefore it is not difficult to account for the mistake, whichever way it may be; and I am not sufficiently learned to clear up the affair, though I think it was in the reign of Titus.

Jean. Was the first recorded eruption of Vesuvius as severe as some of the later ones?

Miss Angerstein. Yes, my dear. It was at that time accompanied by an earthquake, which overthrew several cities in Campania, but more particularly Pompeii and Herculaneum. Sir William Hamilton, who was ambassador to the court of Naples, mentions that the eruptions which he wit-

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nessed in 1767, was the twenty-seventh from the first upon record; since which there have been several others; but the most violent and alarming were those in 1779 and 1794. In the last of these, five thousand acres of rich vineyards were destroyed, and most of the town of Torre-del-Greco buried or rendered uninhabitable.

ADEXANDER. But Herculaneum was not quite buried, was it? for mamma has some corn that came from it, very parched and black, certainly.

MISS ANGERSTEIN. Yes, it was quite buried in the lava, but not so totally destroyed as Pompeii; for in the beginning of the last century this famous city was discovered by some labourers digging for a well; and in 1733 fresh attempts were made, and many of the houses were found furnished, with the furniture in good preservation. Since that time a prodigious number of busts, statues, manuscripts, paintings, and household utensils have been dug from the ruins, which contribute much to enlighten our ideas, and increase our knowledge of the ancients. These valuable antiquities, so miraculously recovered, are preserved in the museum of Portici, a small town in the neighbourhood.

JEAN. Has Pompeii never been discovered?

MISS ANGERSTEIN. About forty years after the discovery of Herculaneum, an attempt was made to penetrate into this unfortunate city also: one street and a few detached buildings of this town have been cleared. The street is said to be well paved; and

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narrow causeways are raised a foot and a half on each side, for the convenience of foot-passengers. Traces of wheels of carriages are also to be seen on the pavement; and though a few skeletons were found in the street, a considerable number was discovered in the houses.

ELIZABETH. How many poor souls must have perished in that dreadful calamity!

ALEXANDER. But we are forgetting our mineralogical studies, in the woes of centuries long gone by. Did either Theophrastus, Dioscorides, or Pliny classify animals?

MISS ANGERSTEIN. No; they merely *described* such as fell under their notice. Nor do I know who was the first to bring them into order, though *Avicenna*, an Arabian philosopher and physician, who flourished in the end of the tenth and beginning of the eleventh centuries, arranged them into four great classes, viz. 1. Stony bodies;—2. Saline bodies;—3. Inflammable bodies;—4. Metallic bodies. An arrangement which must be well founded; for it has been adopted by almost all mineralogical writers since that period. In the eighteenth century Linnæus published his system. Germany had produced several writers even in the sixteenth century; but all these, as well as Linnæus, differed from Avicenna. In 1758 Cronstedt, a Swedish mineralogist, published his system, which restored the classes of Avicenna to the place they had formerly held. A few years afterwards, Werner illustrated Cronstedt's

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method with copious notes, and his arrangement is exclusively adopted in other countries as well as in Germany.

ALEXANDER. Have we, that is to say Great Britain, produced no eminent writers upon this interesting subject?

MISS ANGERSTEIN. Mr. Kirwan first introduced the Wernerian system into Britain, and may therefore be justly considered the father of British mineralogy. Many others have since written on the subject, but the last edition of his treatise on mineralogy is considered one of the best ever published here.

ALEXANDER. You must be so good as to give us the name of the classes, because we shall have them to learn, and the sooner we know them, the sooner we shall get to something more interesting than mere names.

MISS ANGERSTEIN. Behold the difficult task you will have to accomplish, in committing the classes to memory! Here is the piece of paper containing them, and I really hope you will accomplish it without any uncommon stretch of your intellectual faculties, or experiencing any fatigue from the exertion. Read it Jean, and relieve your brother's anxiety.

Jean took the paper, and read as follows:

"The mineral kingdom is divided into *four classes*.

First Class—Earths and stones.

Second Class—Salts.

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Third Class—Combustibles.

Fourth Class—Metals."

ALEXANDER. Well, I really think I shall not find that quite so difficult as I formerly did Homer. But is that all? I fear this table of classes may prove as deceitful as the geography of Ireland did to me, when I was a little boy; for, having waded through the fifty-two counties of England and Wales, I was delighted when mamma gave me a little slip of paper, containing: "Ireland is divided into four large provinces—Ulster, Munster, Connaught, and Leinster." But, alas! on the following day I found that these large provinces were subdivided into thirty-two smaller torments, in the shape of *counties;* and so I fear your four large classes may be subdivided into a great many smaller parts.

JEAN, *(laughing.)* To be sure, dear Alexander, there must be some other division, or we should know very little about minerals. In zoology the classes were divided into orders, orders into species, and species contained varieties. Will it be the same in the mineral kingdom? are the classes divided into orders?

MISS ANGERSTEIN. No, my love, into *genera;* the *genera* into *species*, and the *species* into *subspecies*, and *varieties*.

ELIZABETH. But how do they distinguish them from each other? What points them out as belonging to the same *germs* or *species?*

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Miss Angerstein. Werner employed *seven universal characters* in the description of minerals.

1. Colour
2. Cohesion
3. Unctuosity
4. Coldness
5. Weight
6. Smell
7. Taste.

Jean. Colour, I should suppose, does not require much comment; but how many colours do mineralogists reckon?

Miss Angerstein. They are not guided by the prism, which (as I believe you all know) divides the solar ray into *seven* colours, *violet, indigo, blue, green, yellow, orange,* and *red,* which are also the colours of the rainbow; but the eight principal colours of mineralogists are such as are considered simple in common life, viz. *white, grey, black, blue, green, yellow, red,* and *brown.* Many other things are to be observed on this head; such as, *shade,* or *intensity of colour; tarnished colours; play of colour; mutable reflection of colour; mutation of colour,* &c. &c. But as you are much too young to become a professed mineralogist, and I much too ignorant to make you such, I shall confine myself to such explanations as are absolutely necessary. My intention is merely to awaken your curiosity to the observation of nature, and to open your minds, by giving you some general ideas of the three great divisions of the natural world; if, afterwards, you feel any inclination to pursue the

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study, I shall be most happy to procure for you such works as will assist you.

ELIZABETH. Will you not give us an explanation of Werner's *universal characters?*

MISS ANGERSTEIN. With great pleasure. Who can tell me the meaning of the second, *cohesion?*

ALEXANDER. As I have been much interested lately with "Joyce's Scientific Dialogues," I will tell my sisters what is there said of it. *Cohesion* is that power which keeps the parts of bodies together when they touch, and prevents them from separating.

MISS ANGERSTEIN. Exactly so. Well then, under this head the *firmness*, *hardness*, and *impenetrability* of minerals are placed. Those that strongly resist fracture are *firm;* those that a blow shivers into many pieces are called *brittle.* Those minerals are *hard* that give fire with steel. Among these are distinguished those that *yield to the file*, as *white copper ore*, &c.; those that yield but slightly, as *flints*, *crystal*, *calcedony*, &c.; and those that do not yield at all, as *diamonds*, *rubies*, *emeralds*, &c. Those which do not give fire with steel, and are with difficulty scraped with a knife, are called *half hard*, as fluors, calcareous spars, basalts, &c. Those which may easily be scraped with a knife, but not by the *nail*, are called *tender* or *soft*, as *mica*, *serpentine*, &c. Those that may be scraped by the nail, are called *very soft* or *tender*, as gypsum, talc, &c. &c.

JEAN. I shall never recollect half this, I fear.

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MISS ANGERSTEIN. You must again provide yourselves with books, and when you have got the explanations from me, you must insert them in your books, and occasionally read them over: by pursuing this plan, you will easily fix as much in your memory as is necessary for you to know.

ALEXANDER. Thanks for the hint. I assure you I will gladly do so, if you will just look it over when written, that I may be sure it is correct.

MISS ANGERSTEIN. Certainly: but we must proceed with the explanations, or we shall not get them over before breakfast. The next is *unctuosity*.

JEAN. I know that means *oiliness* or *greasiness*, but I suppose there are some peculiarities.

MISS ANGERSTEIN. There are four degrees in this characteristic, viz.

1. Hardly perceptible, as in most minerals.
2. Rather greasy, as pipe-clay.
3. Greasy, as Fuller's earth, steatites.
4. Very greasy, as talc and plumbago.

The fourth *universal* or *external* character is *coldness*, of which there are three degrees:

1. Very cold, as quarts, hornstone, jasper, marble.
2. Rather cold, as serpentine, gypsum, &c.
3. Slightly cold, as amber, pit-coal, and chalk.

This character is particularly useful when applied to cut and polished stones, by which they may be distinguished when some of the other characters are lost; and by it also *natural gems* may be distinguished from those which are artificial.

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ELIZABETH. All this must go into our books, and be very frequently read, before it can be clearly fixed in our memories; and when you have completed the seven universal characters, I shall have much to ask you. *Weight*, I think, is the next.

MISS ANGERSTEIN. I have not much to say on that head. I shall merely tell you that this character is most accurately ascertained by taking the *specific gravity* of a mineral, by means of a hydrostatic balance.

JEAN. Must I wait till you have finished these explanations, before I ask the meaning of the hard words you have just made use of?

MISS ANGERSTEIN. No, my dear; I will explain them at once, if you will tell me what puzzles you, or your head will be running upon them, instead of attending to me. Which shall I first tell you the meaning of?

JEAN. Specific gravity.

MISS ANGERSTEIN. *Gravity*, in this instance, means weight; and the *specific gravity* of any body, is its weight compared with that of any other body of equal bulk; so that it is sometimes called *comparative gravity*.

ALEXANDER. I think I understand you. If I had a piece of *wood* and a piece of *lead*, both exactly equal in size to a copper penny piece, the *wood* would be much *lighter*, and the *lead* considerably *heavier*, than the *copper*.

MISS ANGERSTEIN. Exactly so. What would

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you say about the *specific gravity* of your brother's illustration, Elizabeth?

ELIZABETH. I should say that the *specific gravity* of the *wood* was *less* than that of the *copper;* and that the *specific gravity* of the *lead* was *greater* than the copper.

MISS ANGERSTEIN. Very well. Do you clearly understand this, Jean?

JEAN. Yes, I think I do. You mean those bodies whose *specific gravities* you wish to obtain, should be of the same bulk or measure.

MISS ANGERSTEIN. Which do you think would weigh most, a pint measure filled with water, or a pint measure filled with lead?

JEAN. The lead; so I should say the *specific gravity* of the lead was *greater* than the water.

MISS ANGERSTEIN. Ah, I see you have a very clear idea of it, and have well attended to what has been said. Now then I will try to describe to you the hydrostatic balance; but shall first ask Alexander to give us an explanation of the word *hydrostatic*, because he is the only person here who has studied Greek.

ALEXANDER. It is formed of two Greek words which signify *water*, and the science which considers the *weight of bodies*.

MISS ANGERSTEIN. The instrument called a hydrostatic balance, differs very little from the scales in common use. I will make a rough sketch of one. See, to the beam two scale-pans are ad-

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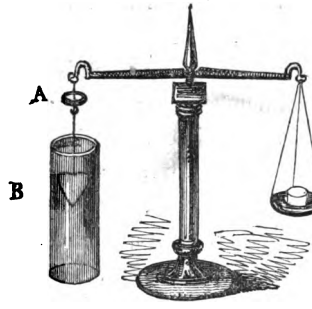

justed, which may be taken off at pleasure. There is a pan, A, of equal weight with one of the others, furnished with shorter strings and a small hook, so that any substance may be hung to it, and then immersed in the vessel of water, B.

JEAN. Without your sketch I should not understand your explanation. What a good thing it is that we have *plumbago* pencils, (looking archly at Alexander.)

MISS ANGERSTEIN. I see by your countenance, Jean, that the expression *plumbago pencils* was intended for Alexander's edification; but let me caution you, my love, not to use it in conversation; because it would be as ridiculous as improper for a female to introduce scientific or technical terms, instead of the commonly received ones.

JEAN. Oh, yes; I know I must still continue to call them *black-lead* pencils, because neither you, mamma, nor papa, ever call them by any other name, though you all know that there is not a particle of lead in them.

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ALEXANDER. Now then shall we go on to the *smell* and the *taste*?

MISS ANGERSTEIN. The smell is only characteristic of a small number of minerals, and is observed either, 1st, of itself, without addition, as in mineral, pitch, and naphtha; 2d, after breathing upon a mineral, as in hornblende; 3rd, after rubbing or striking, as in pyrites, quartz, pit-coal.

ALEXANDER. And the taste. Who would think of *tasting* minerals?

MISS ANGERSTEIN. Why, my dear boy, you never eat your dinner without *tasting* a mineral; but certainly not with any scientific purpose.

ALEXANDER. What part of my dinner can be mineral? I must have the stomach of an ostrich to digest minerals.

ELIZABETH. I think I know, if you would like to be told.

ALEXANDER. Oh! do tell me; for I am sure I never eat any part of my knife which is iron, of my fork which is silver, nor of my spoon which is of the same metal.

ELIZABETH. Salt.

ALEXANDER. How very stupid! To be sure, salt. I do indeed eat a very fair proportion of that agreeable mineral. What could I be thinking of! Metals were the only things that were present to my mind.

MISS ANGERSTEIN. Well then, it is of this one class of minerals only that the taste is a characteristic, viz. salts.

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ELIZABETH. These then are their *external* characters: are there many others to be known?

MISS ANGERSTEIN. I shall not mention every point, my dear; though attention must be paid to their *fracture*, or the appearance of their *internal* surface, when broken; to their *tenacity*, or the resistance they oppose to the stroke of a hammer; to their *flexibility*, or the property of bending without breaking; to their *fusibility*, or property of melting; and also to their *chemical properties;* but as we shall have no opportunity of trying these, I shall say nothing about them at present.

JEAN. Minerals seem odd things. Do they grow?

MISS ANGERSTEIN. Linnæus thus distinguishes the three kingdoms: "Stones *grow;* vegetables *grow* and *live;* and animals *grow*, *live*, and *feel*."

JEAN. Then they do grow?

MISS ANGERSTEIN. They increase in size, but their growth is exceedingly different from the other two kingdoms. The subjects of the mineral kingdom are absolutely passive: they are acted on by external agencies only, and have no power of changing that action, for they possess neither life nor motion.

ALEXANDER. It is most wonderful how they are produced in such quantities, and in such varieties!

MISS ANGERSTEIN. It certainly is. The whole mineral kingdom may be considered as the work-

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shop of Nature, (if I may so express it,) where she secretly labours for the benefit of the creation; but we are ignorant of the way in which she operates, and cannot discover how she forms the various substances she presents to us. Fortunately for us, in the use we make of her gifts, it is of little consequence whether or not we are exactly acquainted with their origin and first principles.

ELIZABETH. It is sufficient for mankind to know how to apply them to the most useful and beneficial purposes. Has it been ascertained what the substance is composed of that we call *mould?*

MISS ANGERSTEIN. The black earth or mould, which covers the surface, consists wholly of the remains of animal and vegetable substances, mixed with sand or loose clay; but this reaches only a little way; and beneath it are deposited in beds or strata, at various depths, clay, gravel, sand, or stone of some sort.

ALEXANDER. How deep have miners penetrated below the earth's surface? two or three miles?

MISS ANGERSTEIN. I am surprised at the last part of your question, Alexander, for I really concluded you knew more of these matters. You are however very far from being right; as no excavation ever made by human art reached beyond three quarters of a mile below the surface. The Ecton copper-mine in Staffordshire is now worked at the depth of four hundred and seventy-two yards only, and this is the deepest mine in England. The mine

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at Truttenburg in Bohemia is, I believe, the deepest that has been worked in Europe, or in any other part of the world; and that is only one thousand yards below the surface, being little more than half a mile.

JEAN. But why do they not go deeper? I should like to know what was to be found towards the centre of the earth?

MISS ANGERSTEIN. There are several reasons, my dear; but one of the principal is the influx of water, which increases in proportion to the depth. Besides this, the want of fresh air, and even the great pressure of the air, would prove fatal to the miners, were they to penetrate much deeper. But we must now draw this long conversation to an end, as we are at home, and the breakfast will soon be ready. I will therefore give you this paper, containing the four great classes, which you may insert in your books, when you have prepared them, and which will, I think, prove very useful to you.

FIRST CLASS.

Earthy Minerals—Being all such as, void of taste and smell, are light and brittle; as *millstone, limestone, flint* or *silex, clay, sand, crystal, spar, gypsum, alabaster, chalk, cornelian, jasper, topazes, sapphires, emeralds, opal, amethysts,* &c.

SECOND CLASS.

Saline Minerals—Such as have a pungent taste,

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heavier, softer than earthy minerals, and partly transparent; as *common salt, sea salt, rock salt, alum, vitriol, capillary salt, nitre* or *saltpetre, soda, borax*, &c.

THIRD CLASS.

Inflammable Minerals—Such as are *light, brittle, opake;* as *diamond, coals, sulphur, black-lead, amber, mineral oil* or *petroleum, mineral pitch, mineral charcoal*, &c.

FOURTH CLASS.

Metallic Minerals—Such as are *heavy, opaque, ductile*, or capable of drawing into wire; and *malleable*, or capable of being worked into shape; as *gold, silver, platina, mercury, iron, zinc, antimony, manganese, arsenic, lead, tin, copper*, &c.

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CHAPTER IV.

THE next morning they were all at the cow-house some little time before Alexander made his appearance, and were beginning to think he had repented of his agreement to form one of the walking-party. Miss Angerstein expressed her fear to Elizabeth, that her brother had found the conversation of the previous morning so uninteresting, that he did not wish to hear the continuation; but Elizabeth assured her he was so much pleased with it, that in order nothing might prevent its renewal in the morning, he had procured paper from his papa, and had prepared his sisters' books as well as his own.

"I suppose, then," observed Miss Angerstein, "he has overslept himself, and is not yet up. If so, we must not wait for him, but take our walk, or we shall lose this lovely morning."

FANNY. Oh, yes, he is up and dressed; for I saw him capering down to papa's room some time ago.

"So did I," said Emily; "for I met him with a little bit of paper in his hand, which he shook in my face, and said he was so happy! but what made him

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so happy he would not stay to tell me; but said I should know presently, when he had seen papa. Oh, here he comes."

In a few minutes Alexander entered the cow-house, and appeared too delighted to be able immediately to explain the cause of his joy. At last, having drunk his milk, kissed his sisters, and capered about for a little while, he offered Miss Angerstein his arm, and they left the farm-yard.

"Now, Alexander," said Elizabeth, "I do think some apology is due for having kept so many ladies waiting so long. What can you say for yourself?"

"Tell us, dear Alexander, what has made you so happy this morning," said Jean.

"What was that bit of paper which you shook in my face?" asked Emily.

"And why did you go into papa's and mamma's room so early this morning?" enquired Fanny.

"Well done, girls!" exclaimed Alexander, laughing heartily, "many questions asked, but no answers waited for. Pray, Miss Angerstein, have you no enquiries to add to the list? because I had better hear all before I begin to answer any."

Miss Angerstein. I think your sisters have saved me all trouble on that head. Answer their queries, and I think I shall be satisfied. I only wish to hint, that I do not like to be kept waiting.

Alexander. I quite agree with Elizabeth, that I ought to apologize for being so late this morning; yet I must trust to your good nature to excuse me

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when you have heard the cause of my detention, to explain which I must first answer Emily's question about the bit of paper. This morning, when I awoke, I found this said bit of paper on my table, containing only the following words :—" Good news, my boy! The Hero, Captain Swanson, is arrived at Cromarty, and will be at Inverness to-morrow or next day."

EMILY. Did papa write that?

ALEXANDER. Yes, he did. Do you now understand why I am so happy, Jean?

JEAN. Indeed I do not; for what can you have to do with the Hero, or Captain Swanson?

" Not much, I grant; yet I am delighted to hear of their arrival."

FANNY. I suppose, as you went to papa, you did not understand what the paper meant; and going to ask an explanation of it made you so late.

ALEXANDER. I perfectly understood its meaning; but I wished to enquire how papa knew the vessel was arrived at Cromarty.

ELIZABETH. I think I partly comprehend. You expect something by the Hero. Is that it, Alexander?

ALEXANDER. You are a very Œdipus, Elizabeth, (if it is allowable to say so to a young lady,) for such is really the case. I do expect a very large package by that vessel, and I was sadly afraid it would not come by the time I wished it. But the little note on my table has quite set my heart at rest, my father having promised to send a cart in for it, to-morrow

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evening or the next morning. Now then, are you all quite satisfied?

JEAN. I assure you I am not half satisfied, for you have awakened our curiosity, and given no explanation to gratify it; for which reason I vote you a very ungallant young gentleman.

ALEXANDER. That is a very severe censure, Jean; and to avoid it I must tell you, I suppose, what the contents of my large package will be.

EMILY. That is exactly what we all wish to know; it is so odd that a boy of your age should receive packages from England.

ALEXANDER. It is such a long story that I shall be tired of telling it; therefore, dear Miss Angerstein, do tell it for me, while I run into the field to speak to Davy.

And off ran the happy boy, leaving his sisters quite mute with surprise, to find that Miss Angerstein was acquainted with his secret.

JEAN. And do you really know, ma'am, what Alexander expects by the Hero?

If you will have a little patience, my dear, I will endeavour to make you as wise as myself. You all know that your papa has been fitting up some rooms upon the ground-floor for your dear grandmamma's use, she having long wished to be down stairs, thinking it would save your mamma much fatigue. They are now quite ready for her, and she is to take possession of her new apartments on your brother's birth-day.

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JEAN. Then the package is, I dare say, something for grandmamma. What can it be?"

"Patience, Jean: you will know very soon, if you will allow me to tell you. It is a Bath chair for your grandmamma, which has been partly bought by your brother, with what he has saved out of his pocket-money."

"Yes," said Alexander, who at that moment again joined them, "*partly* bought, for my kind father has furnished me with a considerable sum to enable me to complete the purchase; and if any of you like to give a trifle towards it, it shall then be our joint present to our dear grandmamma, who will value it so much the more, as coming from all her grandchildren."

"How delightful!" exclaimed the little girls altogether.

"Alexander," said Elizabeth, "I have only seven shillings, so that I cannot give more than five, or I shall have nothing left for the poor."

"And I," said Jean, "have the same as Elizabeth, and will give the same."

"But we," said Emily and Fanny, in a sorrowful tone, "have only two shillings, and that will be nothing to give."

"My dear little girls," said Miss Angerstein, kindly, "it is not the amount of money you can give, but the good will with which it is given, that will make your offering acceptable. Had you more, I am sure you would gladly contribute it, to add to

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your grandmamma's comfort: therefore, as you do the best you can, do not speak so mournfully, but be thankful you have even that to spare."

"But Alexander," enquired Jean, "how came you to think of buying a Bath chair for grandmamma?"

"When I was at the Inverness academy, Jean, I never could make my pocket-money last as it ought to do; but was always obliged to apply to my father for more than my allowance, to pay my little bills with, previous to the vacation. When I went to Eton, my father increased my allowance, and told me, that if I managed it well, and avoided the many temptations to extravagance I should there meet with, he would make me a present, on my birth-day, of a handsome desk, or any thing else I might like better. Before he took me to Eton, we went to Bath, as you no doubt recollect, to fetch my aunt; and there I saw such numbers of invalids being drawn about in chairs, which, from the ease with which they are moved, and the smoothness of their motion, must be invaluable to aged and infirm people. The thought immediately struck me, how delightful it would be, could grandmamma have such a conveyance! and I begged papa that one of those chairs might be my birth-day present, if, at the commencement of the vacation, he found I deserved one. This proved a great inducement to be economical, and in consequence, my weekly allowance has been more than sufficient for all my expences. In addi-

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tion to these small savings, my uncles and aunts were very liberal to me, and I put all their presents aside for the chair, which my father immediately ordered, when I wrote him word how much I had got towards the purchase. Last night, after I was gone to bed, papa heard of the vessel being arrived at Cromarty, and very kindly wrote the little slip of paper which caused me so much pleasure, and made me incur the censure of some of the present party, by keeping them waiting."

"Oh! we all forgive you, dear Alexander," said Elizabeth, "for I am sure I may answer for Miss Angerstein; and if she forgives you, we, as your sisters, must do so too."

"And do you still stigmatize me, Jean, as a very ungallant young gentleman?"

JEAN. Certainly not. You have given us a very satisfactory account of the large package, and we are all very much obliged to you for allowing us to contribute our mite towards the purchase of the Bath chair; which I am now as impatient to see as even you can be, for I have no idea what it can be like.

MISS ANGERSTEIN. A very few days will satisfy your curiosity; and I hope you will attend, my dear Jean, to the instructions which may be derived from your brother's account of the manner in which he obtained his birth-day present.

JEAN. I suppose you mean, it teaches perseverance.

MISS ANGERSTEIN. It certainly in

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severance; but it also shows that the correction of our faults and errors is in our own power, and must greatly depend upon our own exertions. I hope, my dear children, when any of you are tempted to do wrong, you will think of your brother, and grandmamma's Bath chair.

ALEXANDER. As every body's curiosity seems to be satisfied, I suppose we may now resume our yesterday's conversation, and enquire after the more minute divisions of the four grand classes. The first was *earthy minerals*. I have entered the table you gave us in my book, with as much of what you told us as I can remember. You promised to look at and correct it.

MISS ANGERSTEIN. So I will; but you have not offered it to me yet. You must always bring them to me between dinner and tea, if you have written any thing new, and then we will look them over together, which will refresh the memory, and be of service to the whole party.

ELIZABETH. We did so with our last, and found great amusement from them. Jean and I have also inserted the classes in books that Alexander was so good as to prepare for us. What a happiness it is to have so kind and fond a brother!

ALEXANDER. Upon the whole, dear Liz, you are a tolerably kind sister to me; for when I am at home I never have holes in my gloves, thanks to your care; for ever since you could use a needle you have always been willing to do any thing for me that your little fingers could accomplish. I may there-

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fore say, what a happiness it is to have so industrious a sister! But if we waste our time complimenting each other, breakfast will be ready before I make any acquaintance with these earthy minerals. Come, Miss Angerstein, I must beg you to relieve my suspense, by saying how many *genera* I shall have to learn and write down.

Miss Angerstein. I think, my dear boy, we shall go on too fast, if we talk of them this morning. There are some *elementary*, or *accessary constituents* of minerals, which ought first to be considered.

Alexander. I am rather sorry for this, as I fear my memory will be taxed beyond what it will conveniently bear. Perhaps, however, you have kindly provided yourself with a few little bits of paper, which will enable me to oblige my book to share the burden with me, which is an advantage not to be overlooked.

Jean. Now, Alexander, do hold your tongue, and let Miss Angerstein speak. You know very well that you can learn more easily than I can, yet I am not afraid of the lists you pretend to dread so much.

Miss Angerstein. We are indeed wasting our time now, so that it is best I should tell you at once what little is necessary for you to know. How many simple or elementary bodies are there, Alexander?

Alexander. Four, I believe: fire, air, earth, and water.

Miss Angerstein. It was anciently my dear, that fire, air, earth, and wate

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simple bodies, and that all natural substances were ultimately resolvable into them, for which reason they were called the *four elements*. The ancients confessed that the precise nature of fire and air was not known to them. They supposed that the solid parts of the globe were attributable to that element they called earth; and that all liquids were but modifications of the last element, water.

JEAN. And is it not really so? Can there be any more than these four elements?

MISS ANGERSTEIN. It is now proved that neither fire, air, earth, nor water can be called elementary bodies, because they are all susceptible of decomposition; but perhaps you do not understand the difference between decomposition and division?

ELIZABETH. I think I do: division reduces a substance into pieces or parts; but decomposition separates it into the various materials which compose it.

MISS ANGERSTEIN. Very well explained, my dear. If, therefore, a body consists of only one kind of substance, though we may divide it into innumerable pieces, or parts, it is not possible to decompose it. Such bodies are, therefore, called simple, or elementary; and such as consist of more than one of these elementary principles are called compound bodies.

JEAN. Then how many elements are there besides fire, air, earth, and water?

MISS ANGERSTEIN. I have just been explaining to you, that what you once considered as *elements*, or

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first principles, are *compound bodies*, because they are susceptible of being separated with various *simple* bodies. To modern chemistry we are indebted for upwards of *forty elementary* substances. But as we are not going to study chemistry just now, I shall only mention such as are necessary to enable you to understand what we may hereafter talk about.

ELIZABETH. I should, however, be much obliged if you would give me a list of these forty elementary substances.

MISS ANGERSTEIN. With much pleasure, my love; I will tell you the names, and you must write them down; here is a piece of paper and a pencil. Now begin.

Light.	2 Alkalies	Barytes
Caloric	Potash	Silex
Oxygen	Soda	Alumine
Nitrogen	10 Earths	Yttria
Hydrogen	Lime	Glucina
Sulphur	Magnesia	Zirconia
Phosphorus	Strontites	Thorina
Carbon		

TWENTY-EIGHT METALS.

Platina	Nickel	Columbium
Gold	Cadmium	Molybdena
Silver	Arsenic	Tungsten
Quicksilver	Antimony	Chrome
Lead	Bismuth	Osmium
Copper	Cobalt	Irridium
Tin	Manganese	Rhodium
Iron	Tellurium	Uranium
Zinc	Titanium	Cerium
Palladium		

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ALEXANDER. A formidable list indeed of most unintelligible words.

MISS ANGERSTEIN. I shall now give you the list of the constituents of minerals, which must be explained before we proceed to minerals themselves. These are—caloric, oxygen, hydrogen, water, acids, phosphorus, fluorine, nitrogen, chlorine, boron.

JEAN. Now then, I begin by asking what is caloric?

MISS ANGERSTEIN. To which I answer, it is supposed to be a very subtle fluid, extended in a greater or less degree through the whole extent of space, and which penetrates into the interior of even the most solid bodies; and its principal source is the sun.

JEAN. Then I conclude that caloric means heat.

MISS ANGERSTEIN. You are not quite correct, my dear Jean, in your conclusion, because caloric is the matter or fluid which produces on our bodies the sensation of heat; this sensation being only the effect, of which caloric is the cause.

ALEXANDER. But how is it known that such a fluid as caloric exists in nature?

MISS ANGERSTEIN. From its effects. For although caloric is invisible, and possesses no weight, yet it expands bodies in all directions, and in the act of passing from one body to another becomes perceptible to the sense of feeling.

ELIZABETH. How has it been proved that caloric expands bodies?

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MISS ANGERSTEIN. By means of an instrument called a *pyrometer*, which is so constructed as to estimate, in the most exact manner, the various expansions of any solid body by caloric. If you remind me when we go in, I will show you a print of this curious instrument in the Encyclopœdia.

JEAN. Will you explain to me how we can feel the passing of caloric from one body to another?

MISS ANGERSTEIN. Did you ever place your hand upon the marble slab in the hall?

JEAN. Very often, and found it very cold indeed.

MISS ANGERSTEIN. Your hand being warmer than the marble, a portion of caloric passed from it to the slab, and occasioned the sensation of cold. When in winter there is a large fire in the drawing-room, have you ever placed your hand against the front of the marble chimney-piece?

JEAN. Oh yes! and I will try to explain it, that you may see I now understand you. I felt the sensation of heat then, because the marble being warmer than my hand, parted with a portion of its caloric to me.

MISS ANGERSTEIN. Exactly so: another proof of its existence is this—when *caloric* is extracted from *steam* it becomes *water*, and when from *water caloric* is abstracted, *ice* is produced. It is the cause of all fluidity, and to it, even for its form and structure, has every production of the earth been most essentially indebted. I think we may now pass on to the next article, which is *oxygen*. The simplest form in which

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oxygen is found, is the state of gas, in which it is combined with caloric.

ALEXANDER. I hear a great deal about *gas;* but really I do not understand rightly what it is. Will you be so good as to tell me what gas is? I believe it is a fluid, but of what kind I do not know.

MISS ANGERSTEIN. Fluids are of two kinds: one of them, called *liquids,* has, when at rest, a smooth and distinct surface, and is distinguishable both by the sight and touch, such as water, milk, &c. The other, denominated *gas,* or gaseous fluid, has the appearance of *air,* and is not perceptible either to the sight or touch, except under certain circumstances. The name of *gas* is therefore given to any aeriform fluid, which consists of some substance chemically combined with caloric.

ALEXANDER. Many thanks for this explanation, which I think I may say I understand perfectly, because it is so very clear. The derivation of oxygen is, I know, from a Greek word, which signifies, *to produce acids;* but that is the extent of my information.

JEAN. Then we must again apply to our kind friend; for if you do not, it is not very likely we should know why it is derived from that Greek word.

MISS ANGERSTEIN. From its property of converting many substances with which it unites into acids. Oxygen forms one of the component parts of the air that we breathe, and of the water we drink. It is

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essential to animal life, and was formerly called *vital air*, because no breathing animal can live for a moment in any air or gas, which has not in it a mixture of oxygen. All combustible bodies burn with great splendour in it, and when deprived of it, cease to burn. It unites with a great number of substances, and changes both their appearance and properties in a very remarkable manner. In metals, for instance, it entirely destroys the metallic lustre, and gives them an earthy form and texture.

ALEXANDER. And in that state what are they called?

MISS ANGERSTEIN. *Oxides:* lead, for example, combined with oxygen, becomes the well-known red and heavy substance used by painters, under the name of *minium*, or *red-led*, which if deprived of its oxygen loses its red colour, and returns to its former metallic state. Some of the metals are oxidized by being merely exposed to moisture. You must all have observed what we usually call *rust* upon iron. This rust is an oxide of that metal, produced by its attracting oxygen from the air, or from water.

ELIZABETH. How very singular that we should have been acquainted with rust all our lives, and yet been ignorant of its nature and real name! I declare I am nearly as much surprised as was le pouvre M. Jourdain, in "Le Bougeois Gentilhomme," when he discovered, that for the forty years he had lived in the world, he had been speaking prose without knowing that he did so.

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MISS ANGERSTEIN. As your mind expands, and your knowledge increases, you will become still more sensible how very little even the wisest of mankind know, in comparison of what there is still to be learned; yet every increase of information brings additional pleasure to the enquiring mind, and amply rewards our patience and perseverance.

JEAN. The next simple body you mentioned was *kydrogen*. Is that, like oxygen, only to be obtained as a gas?

MISS ANGERSTEIN. These substances can never be had in their pure, simple state, because they cannot be entirely separated either from caloric, or from the other bodies with which they are found united; it is therefore only by their effects, in combining with other substances, that we are acquainted with their existence.

JEAN. How much better I should be satisfied if I could see them!

MISS ANGERSTEIN. Hydrogen is (as Alexander ought to have explained to us) derived from two Greek words, the meaning of which is, *to generate water*.

ALEXANDER. You did not ask me to explain it, my dear Miss Angerstein, or I would have done so most readily. It would, you know, have been a fair opportunity for me to have displayed the vast store of my classical knowledge.

ELIZABETH. Is water then a compound body?

MISS ANGERSTEIN. Yes, my love: water is composed of oxygen and hydrogen, in the proportion

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of about eighty-five parts, by weight, of oxygen, chemically combined with fifteen parts of hydrogen gas, or, as it was formerly called, *inflammable air*.

ALEXANDER. But have these gases, unlike caloric, any weight?

MISS ANGERSTEIN. They are both ponderable substances: an oxide is always heavier than the same quantity of metal before oxidation, which is a decisive proof of oxygen being a real body. Hydrogen, in its purest state, is about fourteen times lighter, and oxygen is a little heavier than atmospheric air.

JEAN. What do you mean by ponderable substances?

MISS ANGERSTEIN. Substances that can be weighed. Hydrogen gas is said to be the lightest of those substances, which is the reason it has been so much employed for the inflation of balloons.

ALEXANDER. The next thing to be explained is acids. Will these occupy us long?

MISS ANGERSTEIN. We must spend some time over them; because I am certain your sisters are totally unacquainted with many particulars relating to them; but I shall be as concise as possible, having many other things to explain, and the morning is wearing away. But what makes you ask this question?

ALEXANDER. Because, to tell the truth, I am not so much interested in these introductory minutiæ, as I hope to be when we happily arrive at the science of mineralogy itself.

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Miss Angerstein. But without these introductory minutiæ, you would not so well understand the subject; therefore have a little patience, my dear boy, and I will endeavour to amuse you better when we have made our way through these preliminary explanations, which, however dry and uninteresting they may appear to you, are absolutely necessary.

Jean. I suppose you think we are sufficiently well acquainted with water, as you are for passing it over.

Alexander. Why, Jean, Miss Angerstein told us of what water was composed, oxygen and hydrogen. Does not that content you?

Jean. I have been puzzling in my own mind, how it could be described; and I cannot settle what I could say about it, if I were required to tell what it was. Will you, ma'am, help me out of my difficulty?

Miss Angerstein. I will endeavour to assist you. Water, when pure, is a transparent fluid, destitute of colour, taste, or smell; but in a really pure state, it can only be obtained by distillation. When heated, water is gradually converted into steam, which is an almost invisible fluid, like air, and the elasticity of which is so great, that it is capable of bursting the vessel in which it is confined, with the most violent explosion. Will that do, Jean?

Jean. Yes, pretty well; because I now understand what a fluid is, or else I might have been still puzzled.

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ALEXANDER. Jean, I am sadly afraid you are not rightly awake this morning. I shall vote that we leave you to take your nap, and proceed in the mean time to the *acids*, which name is, generally speaking, derived from the Latin *acetum*, vinegar.

JEAN. Thank you, sir, for your vote and explanation. I hope, however, to remain sufficiently awake to benefit by some more explanations of the same kind.

MISS ANGERSTEIN. If you are inclined to listen, young people, I am going to give you a list of the acids; but in the first place I must tell you what an acid is. Acids are bodies which have a sharp or sour taste; they have the property of changing the blue colours of vegetables to red, of uniting with water in almost any proportion, of combining with alkalies, (of which we shall hereafter speak,) metallic oxides, and earths, and of forming with them those compounds which are called neutral salts.

ELIZABETH. But of what are acids themselves composed?

MISS ANGERSTEIN. It is one of the most remarkable properties of oxygen, to impart to most of those bodies called acids, their peculiar character of acidity; hence they owe their origin to the combination of oxygen with certain substances, which constitute their bases.

ALEXANDER. How very surprising then, that water is not acid, since it contains such a quantity of oxygen!

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Miss Angerstein. You will not think it surprising, when I tell you the reason, which is this—hydrogen, which, as you all know, is the other constituent of water, is not susceptible of acidification.

Jean. What did you mean by the word *bases*, which you used just now?

Miss Angerstein. Any body with which oxygen combines to form an acid is called the base of that acid. The properties of acids, and, in most cases, their names, are derived from their bases. As I before observed to you, oxygen enters into the composition of most of them; but hydrogen is also the acidifying principle of two or three, as you will perceive from this paper, in which are enumerated such acids as are found in one or more of the minerals, together with their base and acidifying principle. This list must be entered into your books.

LIST OF ACIDS FOUND IN MINERALS.

Acid.		*Base.*		*Acidifying Principle.*
Carbonic Acid	consists of	Carbon	and	Oxygen
Phosphoric Acid	—	Phosphorus	—	Oxygen
Fluoric Acid	—	Fluorine	—	Hydrogen
Sulphuric Acid	—	Sulphur	—	Oxygen
Muriatic Acid	—	Chlorine	—	Hydrogen
Nitric Acid	—	Nitrogen	—	Oxygen
Boracic Acid	—	Boron	—	Oxygen
Tungstic Acid	—	Tungsten	—	Oxygen
Chromic Acid	—	Chrome	—	Oxygen
Molybdic Acid	—	Molybdena	—	Oxygen
Arsenic Acid	—	Arsenic	—	Oxygen
Succinic Acid	—	Carbon	—	Oxygen & Hydrogen
Mellitic Acid	—	Carbon	—	Oxygen & Hydrogen

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The carbonic, phosphoric, fluoric, sulphuric, muriatic, boracic, and arsenic acids, are found in combination with certain of the earths.

The carbonic, phosphoric, sulphuric, muriatic, tungstic, chromic, molybdic, and arsenic acids, are found mineralizing certain of the metals.

The nitric and carbonic acids are found united with potash. The carbonic, sulphuric, muriatic, and boracic acids occur combined with soda.

The succinic and mellitic acids are found in certain combustible minerals.

ALEXANDER. I am really glad to have these lists; for I so often hear and read of the different sorts of acids, that I feel mortified at my own ignorance. Now, by a reference to my common-place books, I shall at least know what some of them are composed of.

ELIZABETH. But will you not tell us a little more about acids, than merely their names and what they are composed of? I should like to become better acquainted with them.

MISS ANGERSTEIN. I will then mention a few particulars concerning some of those most frequently met with. *Carbonic* acid, in a state of gas, is emitted from wine, beer, and other liquors, in a state of fermentation. Water, impregnated with carbonic acid, has an agreeable taste, and sparkles when poured out. The waters of Pyrmont, Spa, and Seltzer, are highly impregnated by nature with this acid. This gas, which was formerly called *fixed air*, is about twice the weight of common air.

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ELIZABETH. What air is it that is so dangerous to miners?

MISS ANGERSTEIN. The carbonic acid gas, my dear, which is sometimes found in the lowest parts of mines, where it is known to the miners by the name of *choke damp*, from the circumstance of its immediately extinguishing flame, and suffocating all animals that are immersed in it, if they are not plunged into cold water as soon as they become senseless. Have you ever heard of the *Grotto del Cane*, near Naples?

ALEXANDER. I have read a good deal about it in one book or another.

JEAN. But I have never heard of it; so perhaps, ma'am, you will be so good as to tell me what there is remarkable in it.

MISS ANGERSTEIN. The *Grotto del Cane* is a cavern near the Lake of Agano, in Naples, remarkable for containing the carbonic acid gas in a state of great purity. From the bottom of this little cave, the gas, or as it is more generally called in common conversation, the *mephitic air*, rises about a foot in height, not in little parcels, here and there, but in one continued stream, covering the whole surface of the bottom of the cave, visible enough to a discerning eye, as a thin fume or vapour; but having this remarkable difference from common vapour, that it does not, like smoke, disperse itself into the air, but quickly after its rise falls back again to the earth.

ELIZABETH. But how do they know that it never rises higher than about one foot?

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Miss Angerstein. Because the darkish green colour of the sides of the grotto marks the height of its ascent, all above that line being common earth.

Jean. How very curious! What size is this cavern?

Miss Angerstein. Very small; being not more than eight feet high, twelve feet long, and six feet broad.

Jean. Why is it called by such an odd name? What have the poor dogs to do with carbonic acid gas, that they should have the honour of naming this grotto?

Miss Angerstein. Unfortunately they have much to do and to suffer there. This grotto is one of the sights which most travellers, who visit Naples, never omit seeing; and with too many it is a constant practice to try the effect of the vapour upon animal life. For this purpose persons attend at the cave with dogs, on which they perform the cruel experiment of holding their heads in the gas: in a few minutes the wretched animals become convulsed, till at last no further signs of life appear than a very weak and almost insensible beating of the heart and arteries; which, if the animal be left a little longer, quickly ceases too, and then the case is irrecoverable; but if it be snatched out before pulsation quite ceases, and laid in the open air, it slowly revives again, and by bathing it in the adjacent lake, it very quickly recovers.

Jean. What horrid cruelty! What hard hearts

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people must have, who could witness such a sight! You have firmly fixed in my recollection one property of carbonic acid gas; for after this story of its fatal effects upon animal, I suppose it would act the same upon the human constitution.

Miss Angerstein. Exactly so, my dear; for the fumes emitted by charcoal are carbonic acid gas; and you must have heard how fatal they have proved in many instances. I think we have now done with this acid. What comes next on the list?

Alexander. The *phosphoric:* I dare say you will have a great deal to tell us about this acid.

Miss Angerstein. On the contrary, I know so little that is interesting about it, that I shall pass it over with merely observing, that when obtained in a state of purity, it is not a fluid, but a white and flaky substance. It is very soluble in water; and in dissolving makes a hissing noise, similar to that produced by plunging hot iron into water.

Alexander. What a mistake I made! I thought to have heard of brilliant illuminations, and many other pretty things. I hope you have something more to say of the *fluoric.*

Miss Angerstein. This acid is found in Derbyshire, and is used for the purpose of etching on glass; and impressions have been taken by the rolling press, from such etchings.

Elizabeth. What do you mean by etching on glass? I have often heard of etchings, but never understood what they were.

Miss Angerstein. Etching is a kind of engrav-

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ing upon copper, (and occasionally upon glass,) by which the lines or strokes are eaten in, instead of being cut with the tool or graver. Aqua-fortis is used for corroding the copper, and fluoric acid acts the same upon glass. The piece of glass upon which the drawing is intended to be etched, is first covered with a thin coating of wax; then the lines are traced, with a proper instrument, through the wax upon the glass; the fluoric acid is then applied by a proper apparatus, when the part of the glass exposed to it will be corroded, so as to exhibit every feature of the drawing.

ELIZABETH. And upon copper how is it managed?

MISS ANGERSTEIN. In a very similar manner. Instead of wax, a light coat of varnish is laid on one side of the copper-plate, which side is afterwards blackened with the smoke of candles. The drawing is then marked out, the plate is surrounded by a ledge of green or red wax, and the aqua-fortis is poured on, which eats into the copper where the lines are drawn, whilst the rest of the plate, which is covered with the wax and varnish, remains untouched.

ALEXANDER. This must be a quick way of engraving, I should think.

MISS ANGERSTEIN. That was its great recommendation in the first instance. To finish the plate, however, it is necessary to use the graver; and this mixture of the tool and aqua-fortis, has given that perfection to engraving which it at present possesses.

ELIZABETH. Is etching a modern invention?

MISS ANGERSTEIN. Though not very modern,

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etching is of a later invention than engraving with the tool, of which it was at first only an imitation. It is not well known to whom the invention is to be ascribed. One of the most early specimens of this style is that print, by Albert Durer, known by the name of the *Canon*, dated 1518. Another etching, by the same artist, is *Moses receiving the Tables of the Law*, dated 1524. It was also practised in Italy, soon after this, by Parmegiano.

ALEXANDER. The next in the list is *sulphuric acid*. I have seen this very often, and have heard it called *oil of vitriol*.

MISS ANGERSTEIN. It is called so when highly concentrated; and when only moderately so, it was formerly denominated *vitriolic acid*, or *spirit of vitriol*. It is a liquid of a somewhat oily consistence, transparent and colourless as water. Like other acids, it never occurs in nature in a pure state, for it can no sooner be formed, than it unites with the earth, alkalies, or metals. Thus alabaster and Epsom salts are formed, the first by an union of this acid with lime, and the latter by the same acid with magnesia.

JEAN. Those beautiful vases mamma has in the drawing-room, are alabaster, aret hey not?

MISS ANGERSTEIN. Yes, my love; and so are the lamps of which you have often admired the soft pleasing light.

ALEXANDER. What! is it possible for it to be worked so thin as those lamps! I always mistook them for some sort of opake glass.

MISS ANGERSTEIN. This mineral being much

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softer than marble, is not capable of receiving a good polish; but such is sometimes its transparency, that it has been employed for windows; and there is now a church at Florence, which receives its light through alabaster.

ALEXANDER. How very strange! The art of making glass having been discovered in such an early period, I wonder they preferred alabaster for such purposes.

MISS ANGERSTEIN. Though the ancients were acquainted with the manufacture of glass, yet they had not attained the knowledge of reducing it into thin transparent plates; they therefore frequently employed alabaster for windows. Of this stone, the Temple of Fortune, in Rome, built by order of the Emperor Nero, was erected. It had no windows whatever, and received only a soft kind of light through the wall, appearing rather as if the light issued from the interior, than that it was admitted from without.

JEAN. And for this beautiful stone we are indebted to the union of sulphuric acid with lime?

ALEXANDER. Yes, dear Jean; and for the Epsom salts which good old nurse is so fond of administering to us, "her dear bairns," in ample spring and autumnal doses, we are also indebted to this same benevolent acid's union with magnesia.

JEAN. With this process of nature I could well dispense, Alexander; for to tell you the truth, I do not admire those said doses; therefore, if you please,

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we will take our leave of them, and talk of something else.

Miss Angerstein. The next acid is the *muriatic*, the component parts of which were for a long time unknown, but which are now said to be chlorine and hydrogen. The name muriatic acid is derived from the Latin word *muria*, which signifies sea salt, or common salt, from which this acid is usually extracted. It was formerly denominated spirit of salt, acid of salt, and marine acid. In the state of gas it is an invisible and elastic fluid, which in mechanical properties resembles common air, and has a pungent and very peculiar smell.

Jean. Can you recollect any thing about this acid that will help to fix it in our memories?

Miss Angerstein. I was just going to mention, that it has been discovered that muriatic acid gas may be successfully employed as a means of correcting putrid and noxious exhalations. It is related in the "Encyclopædia Britannica," that it was applied in this way by M. Morveau, professor of chemistry at Dijon. In the year 1773, the cathedral church at Dijon was so much infected by the corruptions of bodies which had been interred within its walls, that it was entirely deserted. M. Morveau having been applied to for assistance, placed, on a few burning coals, a glass vessel containing six pounds of common salt. Upon this he poured two pounds of sulphuric acid, precipitately withdrew, and shut all the doors. The gas soon filled the whole cathedral.

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After twelve hours the doors were thrown open, and a current of air made to pass through, to remove the gas, when it was found that the noxious vapours were entirely destroyed.

ALEXANDER. That was making a good use of his chemical knowledge, from which I conclude that M. Morveau was not only a clever man, but a useful member of society; for he turned his aquirements to the benefit of his fellow-creatures.

ELIZABETH. It would, indeed, have been a grievous thing for a fine old cathedral to be useless from such a cause. Would not some such method be of use for fumigating houses where any infectious disorder has been—the typhus fever for instance?

MISS ANGERSTEIN. I dare say it might, my dear, upon a small scale, by substituting drachms for pounds; but there are so many others in general use, and much more agreeable, that I think you and I will not puzzle ourselves by arranging a new one.

ALEXANDER. You really make these acids quite delightful, by interpersing them with these illustrative digressions. I was really sadly afraid they would prove dull subjects for conversation, but you have greatly enlivened them, and I think fixed them safely in our cullender heads.

ELIZABETH. My dear Alexander, Jean and I feel greatly indebted to you for classing our heads under so slighting a term as cullender; but as you place your own there, I suppose we must not take offence at it.

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ALEXANDER. I meant none, I assure you; though, unless your heads have changed characters since we used, like good little children, to learn our little lessons together in the nursery, the term is by no means misapplied; for I recollect nurse often complaining of the sieve-like property of our brains. "In at one ear and out at the other," was poor mamma's complaint of us all, when she used to teach us. But had we not better proceed with our acids and gases? The next in our list is the *nitric*, composed of nitrogen and oxygen. What nitrogen may be I cannot say.

MISS ANGERSTEIN. You will know by and bye. There are many of the bases with which you are at present totally unacquainted; but I shall give you a concise explanation of them when we have done with the acids; the remainder of which will not occupy us very long, for I have but little to say about them.

ALEXANDER. That I am sorry for: I have taken a great fancy to your illustrations, and am as much interested in these morning conversations, as Elizabeth and Jean prophesied I should be.

MISS ANGERSTEIN. I shall then be very happy to continue them, and shall feel amply rewarded for the many hours I spend in searching for such explanations as may enable me to make the subject clear to you. You would hardly believe how many works upon chemistry and mineralogy I consult; nor how much dry reading I encounter, before I can

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select such points of the subject as are suitable to your young minds.

ELIZABETH. And is it for our improvement and amusement, that I have lately seen you so surrounded with books, that I have sometimes wondered what use you could make of so many volumes at a time?

MISS ANGERSTEIN. Exactly so, my love. It is impossible for any instructress, however well educated she may be, to have more than a general knowledge of such complex studies as chemistry and mineralogy; therefore, if she wishes to give her pupils clear ideas of even the first principles, she must not disdain to make use of every work within her reach; that, by comparing and selecting, she may become well acquainted with them herself, before she attempts to explain them to others. This has, of late, been the constant occupation of all my spare time. I have examined every book in your papa's library, from which I might obtain a hint even, that would throw any light upon our subject; and I look for my reward in your improvement, not only in this, but in every branch of your education—in your attention to my wishes, and in your affectionate behaviour to each other, and respectful obedience to your dear parents. Then, indeed, I shall have no cause to regret having left my native land and beloved sisters, to take charge of your education; and as I really am attached to you, my dear children, I feel doubly solicitous for your welfare.

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ALEXANDER. I think it was a happy day for us, when mamma first became acquainted with you; and I do hope we shall always recollect how much we all owe to you.

MISS ANGERSTEIN. Your obligations can neither be great nor numerous to me, my dear boy, since our acquaintance is but of late date.

ALEXANDER. Perhaps not personally; but my father says every individual of the family is indebted to you for the change you have wrought in my sisters; and he, as well as mamma, is always inculcating upon us, how indispensably it is our duty to contribute to your happiness by every affectionate attention in our power; and from experience I can now say, how ungrateful we should be were we to omit doing so.

ELIZABETH. Yes, Alexander, I told you that you would soon love Miss Angerstein as well as I did; and you find I was not mistaken.

Miss Angerstein kissed the affectionate girl; and as they were at home, and breakfast was nearly ready, the consideration of the remainder of the acids was obliged to be deferred till another morning. A good appetite made them all very quick in the necessary duties of the toilet, and they soon assembled with happy countenances round the breakfast-table, having first received their morning's embrace from their affectionate parents.

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CHAPTER V.

For several mornings the weather was so damp and unfavourable, that the young people were obliged to forego their walks and conversations; but having now begun to estimate the value of time, they no longer passed it in bed when they could not walk, nor when up did they idle it away. Alexander, Elizabeth, and Jean, were busily employed in arranging their common-place books, and in endeavouring to recollect as many particulars of the previous conversations as their young minds had retained. They entered the various lists Miss Angerstein had given them, very neatly in the books appropriated to that branch of natural history which at present occupied their attention. The younger ones, Emily and Fanny, remained in the nursery, playing with their little brothers, who were delighted to have a good game at romps, and hailed a wet morning with much greater pleasure than their nurse, who did not like the noise of their joyous games quite so well as they did themselves. Emily and Fanny were, however, very orderly in the nursery, and did exactly as they were desired; being perfectly aware that any mis-

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conduct there, if reported to Miss Angerstein, would incur her displeasure, and prevent all future enjoyment with their little companions upon rainy mornings.

Mr. M'Ivor, as he had promised, sent to Inverness for the large package which his son so anxiously expected by the Hero. It arrived quite safely, and great was the delight of the young people at the sight of this chair, which was to enable their dear grandmamma to take the air, and once more enjoy the sight of the shrubs and flowers in the grounds. The rooms were ready for the old lady's reception, and consisted of a large, airy, and handsomely-furnished sitting-room; having a bow-window looking upon the lawn and down the avenue leading to the house, and a large French window on the other side, opening upon the broad gravel walk in the shrubbery, made sufficiently wide to admit the Bath chair, that the invalid might be placed in it in the rooms. This was to be her usual sitting-room, when well enough to be removed to it; but there was a smaller one, fitted up with every comfort required by an invalid, intended for those periods when the severity of the weather, or any increase of indisposition, rendered the retirement of a smaller apartment more agreeable than the large one. A spacious, but comfortably warm bed-room was situated between the two sitting-rooms, with a smaller one adjoining it, in case of Mrs. M'Ivor's judging it necessary to pass the night near her mother,

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when not obliged absolutely to sit up with her. Nothing was omitted that could contribute to the convenience and happiness of its intended inhabitant, who looked forward with an almost childish delight to the time fixed upon for her taking possession. Elizabeth and Jean, under Miss Angerstein's direction, had ornamented the small alabaster vases on the mantel-piece, with a great number of those most graceful little things, the *willow alumeltes*. Emily had made a pretty straw shred basket to stand on the drawing-room table, and little Fanny had manufactured a pen-wiper in the shape of a carnation. The dahlia screens on the mantel-piece were Miss Angerstein's little offering. In short, every one contributed something towards the embellishment of grandmamma's new abode.

The morning which was to display all these treasures to her eyes, was expected with great anxiety by every member of the family. It did not absolutely rain, but was dull and cloudy; and poor Alexander, who was awake as soon as it was light, thought he had never seen the weather so unpromising upon any of his former birthdays. He got up rather heavy and depressed in spirits, fearing that he should not have the happiness of drawing his grandmamma in her new chair for the first time. Besides, he had to go and collect the prettiest flowers the garden afforded to decorate the new rooms. He dressed quickly, and upon looking out of his window, he fancied the morning was brighter. "Cer-

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tainly," he said to himself, "that heavy cloud looks less black than it did some time ago, when I first saw it." This comforted him a little; and by the time he had received the affectionate congratulations of his sisters, admired their various useful and pretty presents to him, attended prayers, and got his hat, the sun burst forth, and gave promise of a fine day; and as one dark cloud rolled away after another, the happy boy's cares all vanished, and he went gaily into the garden, followed by his sisters, to gather the bouquets.

Miss Angerstein was too well acquainted with the human mind, and more especially with the minds of children, to attempt engaging their attentions to any studies, or even to their much-loved mineralogy, upon such an eventful morning as this. She left them to their own pursuits, assisted them in choosing such flowers as best suited the apartments of an invalid, guided their taste in the arrangement of them, and allowed her young charges to be happy in their own way, because that way was rational, and did not lead them into mischief and folly. If young people did but consider how greatly they would add to their own indulgences, by a strict attention to the commands and wishes of their parents and instructors, they would surely try who could be most obedient. Some young people are not to be trusted out of sight, or they immediately do exactly contrary to what they ought: such however was not the case with the Inch Cairn family. They had

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bounds prescribed to them, beyond which nothing was to tempt them to go; and within these limits they cheerfully amused themselves, when allowed by their indulgent instructress to refresh themselves with half an hour's absence from the study. When the weather was wet, and would not permit of out-door amusements, they could be trusted to play in the hall, without any chance of their entering into familiar conversation with the domestics of either sex; for they had been taught that it was their duty to behave with the greatest civility, and even with kindness to servants, but that all approaches to familiarity were to be carefully guarded against and avoided. It must be owned, that when first placed under the watchful care of Miss Angerstein, the amusements of the young people did not proceed so amicably and agreeably as at the time we are now speaking of; for Jean's excessive hastiness of temper produced continual quarrels with her younger sisters, and made even the habitually gentle Elizabeth sometimes to be betrayed into a sharpness of answer, and an inclination to dispute, very foreign to her natural disposition. Now, however, things were much better arranged. Jean had been convinced, not only of the impropriety, but of the injustice, of always desiring to have things according to her will, without conceding a little to the wishes of others; and though she, unfortunately, forgot occasionally the lessons of humility and self-denial which had been inculcated, yet she was, upon

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the whole, much more obliging and good-tempered than formerly; and even when she did trangress, she very soon listened to the voice of reason and affection, owning herself in the wrong, and yielding to be guided by the advice and opinion of those older and wiser than herself.

Breakfast-time at length arrived, and the merry group having arranged the flowers greatly to their own satisfaction, in grandmamma's different rooms and passages leading to them, they all quietly placed themselves at the breakfast-table, wondering what made papa so late, and where Alexander could be. They, also, shortly made their appearance; Alexander carrying a handsome rosewood desk, inlaid and bound with brass, which he was eyeing with peculiar satisfaction. It was a present from his fond parents, as a reward not only for his economy and obedience to their wishes, but for his affectionate solicitude for the comfort of his afflicted grandmother.

"See!" he exclaimed, as he entered the breakfast-room; "see, Miss Angerstein! see, sisters! what my dear father and mother have given me. Is it not a handsome one? is it not a great beauty?"

"Oh, Alexander! will not my mother-of-pearl paper-cutter suit it exactly?" asked Elizabeth.

"And the penknife I gave you?" said Jean.

"And the wafer-seal?" added Emily.

"And my pen-wiper, Alexander? I think that will look very pretty in it," said Fanny.

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"Indeed, dear sisters," said the grateful boy, puting down his desk, and brushing away a tear which would have been no disgrace even to a more manly cheek, "indeed, dear sisters, you are all too good and kind to me; and when I am a man I hope I shall never forget your kindness, but love you all dearly."

"Then shall we put them all in at once?" asked Fanny, impatient to see how her pen-wiper would look in the handsome desk.

"Not now," said her father: "wait till after breakfast, because your mamma wants it over, that she may go to grandmamma; and while she is dressing, you can arrange Alexander's desk. After she is dressed, and brought down stairs, you may go quietly in, to see and welcome her to her new apartments, and to offer your joint present of the Bath chair, to which I find you have all contributed as much as was in your power. Now let us get our breakfast, for we have much to do on this happy day."

They all once more placed themselves at table, and partook of a cheerful meal. This being a birth-day, the saucers of porridge did not appear; but the young people were indulged with tea or coffee, bread and butter, or dry toast. A Scotch breakfast-table is always well covered. Bread of every kind, white and brown, toasted and untoasted, oat cakes and barley bannocks; dried salmon and speldings, boiled eggs and hard eggs, honey and preserves of many

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kinds, besides the delicious Scotch marmalade. On a side-table are placed cold meat, fresh and salt, and a stand of liqueurs. All this the children were accustomed to see; but as their mamma thought porridge and milk much more wholesome for them, they never asked, nor apparently wished for any thing else. After they had eaten their allotted portion, if they wanted more, they finished with bread and a little butter, honey, or marmalade. On such privileged days as birth-days, they were allowed to partake, in moderation, of such things as were suitable for them; and as they could have porridge every day, they did not regret breakfasting without it occasionally.

Breakfast being over, Mrs. M'Ivor went again to her mother, who was very desirous of accomplishing her removal down stairs. The day was particularly favourable for the change. The mists of the morning had all rolled away; not a cloud was to be seen in the clear blue sky, in which the sun was travelling with unveiled splendour; scarcely a breath of the gentle south breeze blew strong enough to move even the leaves of the aspin, that most tremulous of all trees. Even in that northern latitude the sun had power to drive the cows into the pool of water, where they stood motionless, as if enjoying the delightful freshness of their cold bath; the sheep were seeking shelter under the hedges and trees, and every thing bespoke a hot August day.

The young people first arranged all Alexander's

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presents in his desk, admired it over and over again, and then adjourned to the summer-house, where they were joined by Miss Angerstein and two of the young ones from the nursery, whom she had brought with her to decorate with a birth-day garland. Immediately all hands were busy in weaving garlands to decorate the Bath chair, that it might look very gay when presented to grandmamma. While they were thus employed, the good old nurse came with the sweet baby in her arms, to bring Martha Pierce to the young ladies. Martha was now grown quite strong and healthy, but she was too grateful ever to forget the kindness of those who had contributed to her recovery; and as some slight acknowledgment for their attention to her during her illness, she had employed herself, ever since sunrise, in making wreaths and garlands for the young ladies. She now humbly offered them to their acceptance, and selecting a very prettily-made coronet from her gay burden, she begged she might be allowed to put it on her dear Miss M'Ivor's head; "because," said Martha, "'twas she that first thought of bringing me some warm milk: madam told mother so. Oh, dear! but I forgot. Mother told me, that as this was the young laird's birthday, I was to be sure and give him his ball, which I have made for him, before I said any thing to Miss. But you will not be angry with me, master, will you?" and the poor little girl looked most imploringly up in his face, at the same time producing a very round and nicely-

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worked ball. "I am afraid," continued Martha, "it will be of no use to you. I wish I could make you a goff-ball, but I cannot."

Alexander assured the little girl he was quite delighted with the ball she had brought him, and with which he and his sisters should have many a pleasant game. Martha then presented a pretty nosegay to Miss Angerstein, gave each of the young ladies a wreath, and then dropping a curtsey, was returning home, when Alexander asked Miss Angerstein if she thought he might ask Martha to dine either with the servants or in the nursery.

"I am sure your mamma will have no objection to your doing so; therefore run after her, and beg her to stop and spend the day here."

Alexander did not require twice bidding, but spoke to Martha with the greatest gentleness and kindness, who said she should like to do so very much, but she must first go home and tell her mother, lest she should be uneasy at her absence, which was accordingly agreed upon; and the happy party, after having decorated themselves with Martha's presents, resumed their former occupation of garland-making, and greatly improved their manufacture, by observing the method with which Martha had wove hers.

Miss Angerstein was busily occupied in making a cockade of blue corn-flowers, to adorn the cap of the fair and fat little creature in the nurse's arms, that it might not be without a share of the birth-day

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finery; and promised the two little nurselings she had brought with her, to ornament their heads with garlands, when she had finished baby's rosette. The happy party formed a most interesting group, surrounded by flowers of every hue, the elder ones already crowned with garlands of Martha's manufacture, and employed in the pleasing occupation of weaving others to adorn the chair, the dear baby crowing with delight at the sight of so many gay flowers; the two young ones standing close to Miss Angerstein, watching with anxious eyes the progress she was making in their wreaths, and offering her double the number of flowers she could accept from their busy little fingers, their youthful countenances all beaming with innocent happiness, unclouded by any past cares, and unmindful of any future trouble, the happy present engaging their sole attention. Unperceived by any one, Mr. and Mrs. M'Ivor stood for some minutes at a little distance, contemplating the pleasing scene. The undisturbed harmony which seemed now to be established among their children, was a source of real enjoyment to them. Pointing to his joyous family, the fond father pressed his wife's hand, and whispered to her, "This is the due and meet reward for your own filial affection, and for the unremitting tenderness you show to your own mother. God grant your children may prove worthy of you!" They then advanced to the summer-house, and added their efforts to assist in embellishing the chair.

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They were eagerly asked if grandmamma was ready to see them; but Mr. M'Ivor told them she was rather fatigued with being carried down stairs, and overcome with pleasure at the sight of her new apartments; it was therefore better she should be left to her maid's care for a little while, in the hope of recovering herself by rest and quiet, but that they should all pay her a visit very shortly. Martha Pierce's visit was related by the children, and her presents shown, when Alexander enquired what sort of a game was *goff*. "I know, papa," said he; "it is one of the favourite amusements of dear Scotland, but I never saw it played, nor do I know how it is played, excepting that a ball is necessary."

Mr. M'Ivor. It is a diversion, my dear boy, which was originally peculiar to Scotland, but is now much practised in England. It requires an equal degree of art and strength, and is played with a bat and a ball. The ball is smaller and harder than those used for cricket, and the bat is of a taper construction, till it terminates in the part that strikes the ball, which is loaded with lead, and faced with horn. An expert player will send the ball an amazing distance at one stroke; each party follows his ball upon an open heath, and he who strikes it into a hole with fewest strokes, wins the game.

Alexander. I had no idea it was ever played in England.

Miss Angerstein. I have frequently seen it played upon Blackheath, in Kent; and was at first

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much puzzled to know what amusement the gentlemen could find in walking over the Heath, followed by an old Greenwich pensioner bearing a bundle of taper bats under his arm.

JEAN. And *curling*, papa: what sort of a game is that? it is such a curious name.

MR. M'IVOR. That diversion, my dear, is, I believe, entirely confined to our nation, and can only be played in winter; as it is performed upon ice with large flat stones, often from twenty to two hundred pounds weight each. These are hurled from a common stand to a mark at a certain distance; and whoever hurls the stone nearest the mark, is the victor.

ALEXANDER. What a laborious game curling must be! I do not think I should enjoy it much, it requires such uncommon exertion to hurl such heavy stones. I prefer a good game at cricket in summer, and foot-ball in winter.

MR. M'IVOR. They are much more suitable to your age and strength. But come, I think the chair is now quite gay enough, and our little cherubs' heads are equally smart, so that we will go and see whether grandmamma can admit us; and if the evening proves as fine as the day, you shall have a dance on the lawn. I have sent word to poor blind Duncan to be here with his violin.

"Thank you, papa! thank you, papa!" resounded from many glad voices: "how very delightful that will be!"

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"I shall go first and see if my mother is ready and able to receive so many visitors," said Mrs. M'Ivor; "for it will never do to try her weak spirits too much. If I do not find her better, you little girls must defer seeing her till to-morrow: as it is your brother's birth-day, grandmamma must see him."

"And we shall not give her the chair!" began Jean, allowing her natural impetuosity to get the better of her anxiety for her grandmamma's health; but recollecting herself in a moment, she added, blushing very deeply, "I forgot: dear Alexander can do that for us."

"And as a reward for the self-command you have just exercised, my dear child," said her father, with an approving smile, "I hope your grandmamma will be well enough to receive you all. It gives me great pleasure, Jean, to find you thus struggling with yourself; and it will bring its own reward, I assure you, in the inward peace and satisfaction you will experience from the consciousness of doing your duty;" and the fond father kissed Jean's burning cheek, which encouraged the little girl in the effort she had just made, and she inwardly resolved to endeavour to become every thing her kind parents could wish her.

Alexander, perceiving that his sister's embarrassment increased from the silence which succeeded his father's address to her, endeavoured to relieve her by chatting about various things. At last he said:

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"You have been at Blackheath, then, Miss Angerstein, and can perhaps tell me something about a wonderful cavern which I once heard was in that neighbourhood. Indeed, I read in 'Brooke's Gazetteer' some few particulars, but only just enough to excite my curiosity. Did you ever see it?"

Miss Angerstein. Though I have frequently been staying for weeks together on the Heath, and have greatly wished to see this cavern, yet I have never as yet paid it a visit; but should I ever go again, I will endeavour to gratify my curiosity.

Alexander. But cannot you give me some account or description of it. It would amuse us just now, while we are waiting for mamma's report, and I dare say you know more about it than "Brooke's Gazetteer" told me; of which all I can recollect is, that such a cavern exists, and that it has got a well of pure water in it. Is that all you know?

Miss Angerstein. Not quite; for I can tell you how, and when it was discovered.

Elizabeth. Then pray do, for I have never before even heard of this cavern.

Alexander. What a happy fellow I am, to have thought of this just now, when we want something to divert us, and prevent our being impatient!

Emily. And it is so long since you have told Fanny and me any thing like a story.

Miss Angerstein. This, my love, will not be much like a story, but if it will interest you, I will

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tell you all I have been able to learn about it; and I have made many enquiries, besides having sought for some account of it in various books. This singular cavern is situated between Blackheath and Deptford, about half way down the hill, and at some little distance from the high road, on the north side. It was discovered in 1780, by some workmen employed in digging the foundations of a house. The entrance is by a flight of steps descending about fifty feet, and leads into a range of seven irregular chambers, cut out of the solid chalk, and communicating with each other by small avenues. The apartments vary in size, but the general measurement is said to be from twelve or fifteen to thirty-six, or even forty feet in length and width.

JEAN. But where is the well Alexander mentioned?

MISS ANGERSTEIN. The well is in the lowest chamber, and is about twenty-seven feet deep. It formerly afforded very fine water; but I believe there is very little in it now.

Mr. M'IVOR. How deep is this cavern below the surface of the ground.

MISS ANGERSTEIN. The greatest depth of the lowest part, is said to be nearly one hundred and seventy feet from the surface; and its length, from the entrance, about the same.

ALEXANDER. Is it known for what purpose this cavern was excavated, or what use it was ever put to?

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Miss Angerstein. It was, as I before mentioned, discovered by accident, and nothing was ever found in it which could throw the least light upon its former use. For what purpose it was constructed I have never even heard a surmise.

Mr. M'Ivor. It was most probably intended as a place of concealment, as such excavations usually were.

Alexander. I am very fond of hearing about such strange places, and I wish, papa, either you or Miss Angerstein would tell us of some others. Think a little, and try if you cannot recollect something very amusing.

Miss Angerstein. In my common-place book, I have some account of the *Adelsberg Caverns*, which I extracted from "Russel's Tour in Germany." If any one will fetch the book, you may amuse yourselves by reading it, if your papa cannot afford you any better entertainment from the stores of his memory.

Mr. M'Ivor. I think you cannot do better; for I can think of nothing in the way you wish, except what Swinburne, in his "Travels in Italy and Sicily," relates of the singular property possessed by the vaults of a Capuchin convent, in the Achradina, in Syracuse, that of drying the bodies of the dead in a very short space of time, so that the features and figure were preserved.

Elizabeth. How very odd that was! It was far better than embalming, as the Egyptians used to

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do, because they covered up the face, and disguised the figure by bandages of cerecloth.

Mr. M'Ivor. Certainly; for after the bodies of the monks were thoroughly dried, they were dressed in their religious habits, and placed as statues in niches, on each side of subterraneous passages.

Alexander. What a grim array! I think the old monks would have been better placed in coffins; for who would ever go to see such a dismal sight as a range of dead bodies must be? Well, I will run for your book, Miss Angerstein, and hope for no little entertainment as my reward.

And away he ran, returning in a few minutes with the book in his hand.

"Now," he exclaimed, "who will read it? for I am too much out of breath to offer my services," and he laid the book on Miss Angerstein's lap.

"Jean, will you undertake it?" asked Miss Angerstein.

The little girl gladly accepted the offer, and as it was written in a neat, legible hand, she read it fluently, and with proper attention, showing that she was interested in, and understood what her eye rested on.

"ADELSBERG CAVERNS.

"The village of Adelsberg stands at the bottom of an inconsiderable rocky eminence. At the western extremity of the eminence the rock gapes into two large apertures. The one reaches nearly from its

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summit to the level of the plain, and has an irregular, jagged, cleft-like shape; the other is rather more to the eastward, about fifty feet higher in the rock, and in a much more regular vaulted form. The river Poick comes winding along the valley, from the south, flows under the eminence, reaches the western extremity, throws its whole body into the lower of the two openings, which it entirely fills, and disappears. The higher opening runs a short way into the mountain, forming a regular and spacious gallery. The partition of rock that separates it from the lower one, through which the river holds its course, is broken through in several places, and furnishes, here and there, a glimpse of the dark waters fretting along in their subterranean channel. But, as you advance, their murmurings, and the distant gleams of daylight die away together, and the silence and darkness of ancient night reign in all around."

ELIZABETH. I hope you will forgive me for interrupting you, Jean; but I have not the slightest idea where these caverns are, that you are reading about; therefore I wish to ask Miss Angerstein, that I may understand better their situation.

JEAN. I stopped for exactly the same purpose; for if I know where they are situated, I shall remember so much better the account of them: and I do not think this extract mentions even the country they are in. Will you be so good, ma'am, as to solve this difficulty for us?

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Miss Angerstein. Adelsberg is a village in Carmiola, which forms part of the Austrian empire. I never could find it in any gazetteer; but according to the maps it is about ten miles north-east of Trieste, which is, as you all know, a sea-port on a gulf of the same name, to the north-east of the Adriatic Sea.

Mr. M'Ivor. I really did not know where it was, but waited in the hopes Jean would enlighten me as to what part of Germany this village was in. I like this laudable curiosity, my dears, which will not allow you to pass any thing over you do not clearly comprehend: it is a sure way to clear the cloud of ignorance from your minds, if you treasure the answers to your questions in your memories. Now Jean, we are, I believe, ready to listen to you again, so go on my little girl.

(Jean continues reading.)

" The guides now light their lamps, and in a short time the distant sound of water is again heard: it becomes louder and louder; the passage seems to widen, and at length opens out into an immense cavern, which the eye cannot measure; for the lamps are altogether insufficient to penetrate to any distance the darkness which is above, and around, and below; they are, in general, but just sufficient to show where you stand, which is a ledge of rocks, running across the cavern, like a natural partition, but not rising to the roof, divides it into two caverns. From that on the left of the partition, on whose summit you stand, rises, amid the darkness, the furious

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dashing of the river, which has thus far found its way through the mountain, and announcing by its noise the obstacles it encounters, seems to throw itself in despair against the opposing partition, which threatens to prevent its course into the more ample division of the cavern on the right. On this latter side, the rocky partition sinks down absolutely precipitous. The cavern, likewise, is much deeper than that on the left, and impenetrable darkness broods over it. Leaning over the precipice, the ear, after it has become accustomed to the raging of the stream on the other side, hears that its waters, far below, have pierced the partition, and made their way into the deeper and more ample hall of the cavern. The ledge of rock on which you stand, is, in fact, a natural bridge. The impression, however, on this side, is much more striking, for the river is heard eddying along with that dull, heavy, and indistinct sound, which, particularly in such circumstances, among subterranean precipices, and in subterranean darkness, always gives the idea of great depth. The guides light a few bundles of straw, and throw them into the abyss. They gleam faintly, as they descend, on the projecting points of the rock, blaze for a few seconds on the surface of the water, showing its heavy, slow motion; and illuminating, through a small circle, the darkness of the cavern, leaves its gloom, by their extinction, more oppressive and impenetrable.

"On the left, towards the smaller division, the par-

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tition is not so precipitous, and the cavern itself not so deep. A flight of steps has been cut out on this side down to the bottom. The partition itself is pierced in the direction of the great cavern; and when the workmen had got through it, they found themselves still considerably above the bottom; but the rocky wall was here more sloping, and by hewing in it a flight of steps, the bottom of the greater cavern was reached in safety. The great object was, to know what became of the river. When you have advanced a few yards along the rocky floor, which owes much of its comparative smoothness to art, the river is again heard in front, and the lights of the guides again glimmer on its waters. It flows right across the cavern; it has lost its noise and rapidity; it eddies slowly along in a well defined bed, and having reached the opposite wall of this immense vault, the solid mountain itself, it again dives into the bowels of the earth. Its course can be followed no further, and it is still doubtful (notwithstanding all the trouble that has been taken to ascertain it) whether, or where it again appears on earth.

"This vault, imposing as it is, is but the vestibule to the most magnificent of all the temples which nature has built for herself in the regions of the night. A slight wooden bridge leads across the river, and after advancing a little way, the terminating wall of the cavern opposes you. This was always held to be the *ne plus ultra;* but about five years ago (1822) some young fellow took it into his head to try, with

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the help of his companions, how far he could clamber up the wall, by means of the projecting points of rock. When he had mounted about fifty feet, he found that the wall terminated, and a spacious opening intervened between its top and the roof of the cavern, which was still far above. A flight of steps was immediately hewn in the rock, and the aperture being explored, was found to be the entrance to a long succession of the most gigantic stalactite caverns that the imagination can conceive."

ALEXANDER. What can be meant by *stalactite* caverns? Does it mean sparry caverns?

MISS ANGERSTEIN. A stalactite is a stony concretion resembling an icicle, which is sometimes found in the arches of grottoes, and sometimes on the walls of the galleries in mines.

ELIZABETH. What is the cause of its being there? Is it formed by the action of the air on the rock, or by any of the acids you have mentioned?

MISS ANGERSTEIN. Water is a principal agent in the formation of this substance, my love; which, as it oozes through the crevices of limestone rocks, becomes strongly impregnated with minute particles of lime. This water, when it has reached the roof, or side of the cavern, is generally suspended for a considerable time, before a drop is formed of sufficient size to fall by its own weight. In the interval which thus elapses, some of the particles of lime are separated from the water, and adhere to the roof. In this manner successive particles are separated,

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and are attached to each other, until what is called a stalactite is formed. Sometimes the water collects, and drops too rapidly to allow time for the formation of a stalactite; it then falls upon the floor, and there forms an irregular lump of alabaster, which has the name of stalagmite. In some caverns, the separation of the calcareous matter takes place, both at the roof and on the floor; and in course of time, the substance upon each increasing, they meet, and form pillars, sometimes of surprising magnitude.

ALEXANDER. Many thanks for this clear explanation. Now Jean, if you please, read on, and let us hear about these gigantic stalactite caverns.

(Jean resumes the subject.)

"From a large, rugged, and unequal grotto they branch off into two suites: that to the left is the more extensive, and ample, and majestic; that to the right, though smaller, is richer in varied and fantastic forms. Neither the one nor the other consists merely of a single cavern, but a succession of them, all differing in size, and form, and ornament, connected by passages which are sometimes low and bare, sometimes spacious and lofty, supported by pillars, and fretted with cornices of the purest stalactite. It would be in vain to attempt to describe the magnificence and variety of this natural architecture. The columns are sometimes uniform in their mass, and singularly placed: sometimes they are so regularly arranged, and consist of pillars so nicely clustered together, that they resemble the nave

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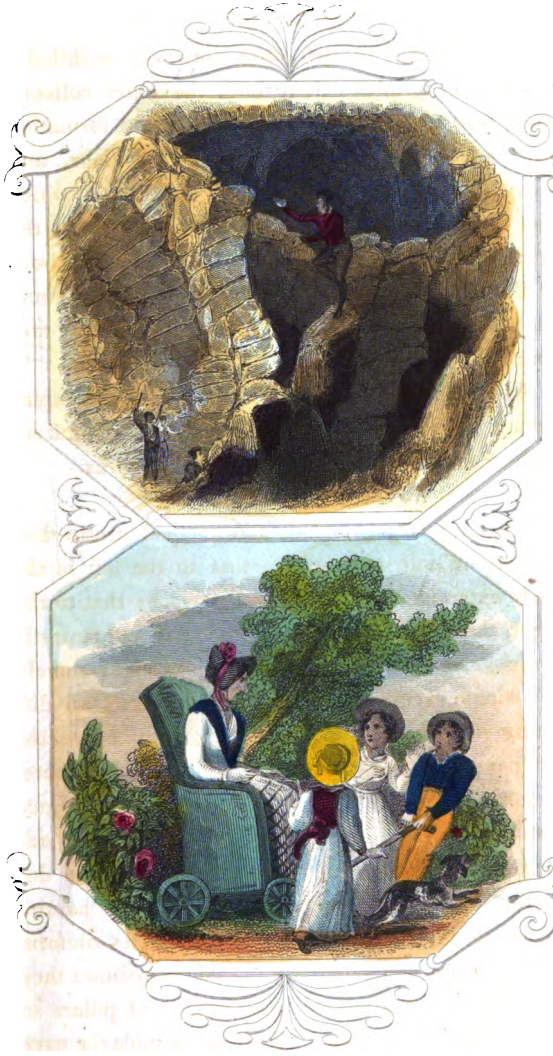

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of a gothic cathedral. Many of these columns, which are entirely insulated, have a diameter of three, four, and even five feet. Frequently the pillar is interrupted, as it were, in the middle, losing its columnar form, and twisting, dividing, or spreading itself out into innumerable shapes. Sometimes it dilates into a broad thin plate, almost transparent by the light of a lamp; sometimes the plate curves itself round in a circular form; sometimes the descending part tapers to a point, which rests on the broad surface of the ascending stalagmite. The walls are entirely coated with the same substance; and in the smaller grottoes it is so pure that travellers have covered it with names written in pencil, some of which have already resisted the moisture of five or six years.

"The other division is more spacious, and extends much further. The caverns which compose it are wider and loftier, but not so beautifully adorned as in the other suite. The enormous clustered columns of stalagmite, which seem to support the everlasting roof from which they have originated, often tower to such a height, that the lights, carried by the guides, do not enable you to discover their summit; but though infinitely majectic, they are rougher, darker, and more shapeless than in the smaller division. The further you advance, the elevations become bolder, the columns more massive, and the forms more diversified; till, after running about six miles into the earth, this scene of wonderment terminates with the

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element with which it began—water. A small subterraneous lake, deep, clear, cold, and dead still, prevents all further progress. As yet it has not been passed; it would therefore be saying too much, to affirm that nothing lies beyond it.

"Throughout these caverns not a sound is heard, except the occasional plashing of the dew-drop from a half-formed pillar. No living thing, no trace of vegetation enlivens the cold rock, or the pale freezing stalactites. Yet these abodes are not always so still and deserted. About the middle of the more extensive of the two ranges, the passage, which though not low, has for awhile been rough and confined, opens into one of the most spacious and regular of all the caverns: it is oval, about sixty feet long, and forty broad; the walls rise in a more regularly vaulted form than in any of the others; the roof is beyond the eye. The walls are covered with stalactites; but except this, nature has been very sparing of her ornaments: the floor has been made perfectly smooth. In addition to the stone seats which the rock itself supplies, wooden benches have been dispersed around the circumference, as well as a few rustic chandeliers, formed of a wooden cross fixed horizontally on the top of a pole. Once a year, on the festival of their patron saint, the peasantry of Adelsberg and its neighbourhood, assemble in this cavern to a ball. Here, many hundred feet beneath the surface of the earth, and *a mile* from the light of day, the rude music of the Carniolian resounds

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through more magnificent halls than were ever built for monarch; and the flame of the uncouth chandeliers is reflected in a blaze of ever-changing light from the stalactite walls, upon the village swains and village beauties who are wheeling round in the delights of the waltz."

ELIZABETH. How beautiful must these caverns be! and how very much more I have enjoyed the account of them, from the explanation you so kindly gave us of the terms stalactite and stalagmite.

JEAN. I do not think I shall ever forget that a stalactite is a concretion resembling an icicle, formed on the roof and walls of caverns and grottoes; and that when the drops fall and form on the floor, they are called stalagmites. A story, or a description of a place, impresses those hard terms upon my mind so much more indelibly than a mere explanation.

MR. M'IVOR. But without the explanation, how would the description be understood, my dear Jean?

JEAN. Oh! now papa, you know what I mean. I want both explanation and description. The explanation alone I might chance to forget; the description alone might amuse me at the time, but would be of no lasting benefit to me: when I can get both, then I am both improved and amused.

Mrs. M'Ivor now came to tell the young people that grandmamma was quite ready to receive them, having had a quiet nap for above an hour, and feeling refreshed and invigorated.

"It is such a lovely day, mamma," said Alexander,

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"I do wish she may be tempted to try her new chair when she sees it."

"I wish she may, my dear boy, because I know what a gratification you would derive in being the first to draw her in it on your birth-day."

It was then settled that all should go at once to see the dear old lady; that they should propose having the French window opened, in which they made no doubt grandmamma would indulge them; Alexander was then to step out, and introduce the chair as a joint present from the whole of the family.

Every thing happened according to their wishes. Grandmamma had the French window open, when they went in; and when she saw the Bath chair, and heard the history of it, she immediately enquired of her daughter whether she thought she might indulge herself and the children by taking a ride in it at once.

"The day is so lovely, my dear mother, I really think you may venture it without running any risk, if you are not already tired with the change of rooms."

Grandmamma said she felt so well and so strong, that she should quite enjoy a short ride in the shrubbery. Accordingly, her bonnet and cloak were instantly produced by her attentive daughter, with whose, and Miss Angerstein's assistance, she was placed in the chair. Accompanied by the whole party, and drawn by Alexander, she made the cir-

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cuit of the sunny part of the shrubbery, to the great delight of the children. Mrs. M'Ivor and Miss Angerstein walked on each side of her, watching her pallid countenance, lest the motion should produce faintness. Nothing could exceed the care and steadiness with which Alexander drew the chair; and on their return home, when relieved from her bonnet and cloak, and laid upon the sofa, grandmamma declared this to be one of the happiest days of her life; the young people experienced the highest gratification, and Alexander felt fully rewarded for all his exertion and self-denial.

Desirous that her children should not be deprived of the pleasure prepared for them by their kind father, Mrs. M'Ivor had ordered an early dinner; after which, blind Duncan having made his appearance, the young party enjoyed a merry dance, in which Martha Pierce and several other little girls, distinguished by Mrs. M'Ivor for their 'good conduct, were allowed to join. Mr. and Mrs. M'Ivor, followed by Miss Angerstein and Alexander, went down several country dances, between each of which the young ones danced reels, poor Duncan not being at all acquainted with music suited to the fashionable dance of quadrilles. At six they had tea, and at eight Martha Pierce and her companions took their leave, blind Duncan was dismissed to the servants' hall to supper, and the happy family having spent a most agreeable and pleasant day, had the satisfaction of hearing, before they retired for the night,

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that their dear grandmamma did not appear in the least fatigued by the events of the day, more than she usually was—that she was not only gone very comfortably to bed, but was also asleep; so good an effect did her ride seem to have had on her.

Before wishing his parents "good night," Alexander gratefully thanked them for the many pleasures they had procured him on his birth-day. His father and mother told him, they were greatly owing to his own good conduct. "Had you not, by dear boy," said they, "curbed your own inclination to wasteful expenditure, you would not have had the gratification of contributing so materially to your grandmamma's comfort, as I think you now have by the present of a Bath chair. Your affection for her, in preferring her comfort to any personal present as a reward, procured for you the desk, which coming to you so unexpectedly, has given you great delight. May you continue to exercise the self-control you have so well begun. God bless you my child!"

Affectionately kissing his parents, Alexander then went happily to bed.

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CHAPTER VI.

So soon as she was dressed the next morning, Elizabeth ran to enquire if any one could tell her how her grandmamma had slept in her new chamber. She fortunately met with Murray, her grandmamma's maid, who gave a most satisfactory account of the night, and said her mistress had not slept so well for some time. This was joyful news, and the affectionate girl hastened to communicate it to Miss Angerstein, who she knew had felt anxious about the effects of the change. In the study she found all assembled, and waiting for her; but when she related what had detained her, and the good report Murray had given, Miss Angerstein was too well pleased with the motive, to make any remarks upon her absence. When prayers and scripture reading were over, they went to the cow-house as usual, took their milk, and then proceeded on their walk by the Burn side.

"Come, dear Miss Angerstein," said Alexander, "we must go on with our acids this lovely morning. I know where we left off: the last you explained was the muriatic, and the one you are going to explain is the *nitric* acid, composed of oxygen and nitrogen."

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Miss Angerstein. Though this is said to be one of the most important acids in the hands of the chemist, yet I have very little to say about it. It is one of the constituent parts of nitre, or salt-petre, and in a pure state is transparent and colourless, like water. By the motion of light, however, it soon becomes yellow; and if exposed to the air it emits yellow fumes, which even tinge the air of the same colour. If it touch the skin, it dyes it of a yellow colour, which is very difficult to be removed; and it is so corrosive as to destroy almost every substance into which it penetrates. If poured upon oils it sets them on fire. This acid, though very abundant in nature, has such an affinity to water, that it is very seldom, if ever, obtained otherwise than mixed with it. It is chiefly known in commerce by the name of aqua-fortis.

Alexander. Aqua-fortis! Oh! I have often heard of that. When I was at the Inverness academy I remember some of the elder boys getting some, to dissolve some pieces of tin.

Miss Angerstein. Yes; it is capable of dissolving all the metals, except gold and platina. It is much used by hatters, for dissolving mercury, for some processes in the preparation of hats; and by dyers for dissolving tin, and forming with madder a scarlet colour.

Jean. What can madder be? Is it vegetable or mineral?

Alexander. I know it is vegetable; but

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whether a tree, a root, or a shrub, I cannot say. For further particulars we must apply to Miss Angerstein.

Miss Angerstein. It is a rough, trailing plant, that grows wild in several parts of the south of Europe; and is much cultivated in England and Holland, on account of its roots, which are used by dyers and calico printers. A peculiar kind is grown in the neighbourhood of Smyrna, and in the Island of Cyprus, which affords a remarkably bright and beautiful colour. Madder is valuable in dyeing, not only on account of its yielding a fine red colour, but also as forming a first tint for several other shades. It tinges water a dull red, and spirits of wine a bright red. When eaten by animals, it stains even their most solid bones. Cows are remarkably fond of the madder plant; and when they freely eat of it, their milk becomes red, yet the cream it affords makes a yellow butter.

Elizabeth. I am very glad our cows do not feed upon madder, for I should not then enjoy my morning draught as I now do. How very disagreeable red milk must look!

Alexander. Perhaps the flavour of the milk might not be much affected: but I never could relish it like the pure white, and deliciously sweet milk that Cherry gave us this morning.

Miss Angerstein. Having nothing more to say of nitric acid, we will proceed to the *boracic*. Which of you can tell me its base, and acidifying

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principles? Jean, I think your countenance says that you can.

JEAN. I think I know. Is not the base boron, and the acidifying principle oxygen?

MISS ANGERSTEIN. Quite right, my love. This acid, in combination with soda, forms the substance that we import from the East Indies under the name of *borax*. When extracted from borax, this acid does not assume the form of a fluid, but appears in thin silvery white hexagonal scales, which adhere slightly together, have a greasy feel, and some resemblance to spermaceti. To the taste it is at first sour, then bitterish, and at last it leaves an agreeable sweetness and coolness on the palate. It has no smell, but possesses the property of changing vegetable blues to red.

ALEXANDER. Of what use is this sourish, bitterish, sweetish acid?

MISS ANGERSTEIN. It is much used in chemistry, and also much employed in the arts, as in soldering, to assist the fusion or melting of metallic substances; and is of great importance to the mineralogist, in promoting the fusion of substances under the blow-pipe.

ALEXANDER. By no means an amusing acid: I hope the *tungstic* will be more so.

MISS ANGERSTEIN. I am afraid you will be disappointed, for I know very little about it and the three following, viz. the *chronic*, the *molybdic*, and the *arsenic*, except that they are, all four, metallic acids.

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ALEXANDER. But I thought that the combination of oxygen with metals, gave them an earthy form and texture. I did not know it produced acids.

MISS ANGERSTEIN. Most metallic substances combine with oxygen in different proportions, and the compounds formed of these substances and oxygen, are doubtless of an earthy texture, and, as I before told you, are denominated oxides. But some of the metals combine with oxygen in greater proportion, which gives them the characteristic properties of acid substances.

ELIZABETH. Those four acids are dismissed in a very summary way. There are but two left—the *succinic* and the *mellitic*.

MISS ANGERSTEIN. We will therefore immediately proceed to discuss them. And first, the succinic acid was formerly called volatile salt of amber; and it was not till towards the end of the last century that its acid properties were discovered. The name of this acid is derived from *succinum*, the Latin name for amber, the substance from which this acid is obtained. It is procured in the form of white, shining, transparent crystals, which are foliated, triangular, and prismatic. The taste is sharp, but not corrosive.

EMILY. Grandmamma has a pretty little yellow snuff-box, which she told me was made of amber. Could you obtain the succinic acid from it?

MISS ANGERSTEIN. It must first be reduced to powder, and then, with a proper chemical apparatus, a small portion might be procured. But do you

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know, Emily, whether amber is an animal, a vegetable, or a mineral substance?

Emily. No, indeed; for I never once thought about it. I always admired it, as being very pretty; but when grandmamma told me it was made of amber I was satisfied, and——

Miss Angerstein. And—as is too often the case—you did not reflect. In this case reflection would have been of little avail, certainly, as the origin of amber is unknown. But I recommend you, my little girl, upon all occasions, to think upon what you see, and not allow yourself to be satisfied merely with a name. When asking grandmamma what her box was made of, and hearing it was amber, any one desirous of information would have enquired about the nature and properties of a substance so entirely new to them: or if you were afraid of fatiguing her by asking so many questions, why not consult that most valuable little book, "The Key to Knowledge?" I hope, as you are now becoming so much more rational in all your pursuits, that your mind will be alive to every object presented to your eyes, and that you will endeavour to learn something new or useful every day, which is the sure way to improve.

Emily. Will you be so good as to tell me where amber is found, and what it is supposed to be?

Miss Angerstein. Most willingly, my dear, shall I always answer any of your enquiries, when I am disengaged; and as much as I know about this

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curious substance I will now tell you. Amber is usually found in round and detached pieces, on the south coast of the Baltic, on the eastern shores of England, and in small quantities on those of Sicily and the Adriatic.

ALEXANDER. But how little, I should suppose, could be procured in that way. I should like to dig it out of mines, as silver and gold are dug.

JEAN. But you know, Alexander, all things are not found in the same way; so you must take them as you can get them. I should like to visit the east coast of England, that I might try and find a piece of amber, for I never saw any amber but grandmamma's box.

MISS ANGERSTEIN. I will show you a piece, Jean, which was found at Scarborough, in Yorkshire, and which has several insects in it.

JEAN. Insects in it! How could they get into so hard a substance?

MISS ANGERSTEIN. Because, my love, there is little doubt of amber having once been in a fluid state; and by some writers it has been said to be a resinous juice in a concrete state; but this is entirely conjecture.

ALEXANDER. And is the only supply we possess procured from the sea-shores you have mentioned?

MISS ANGERSTEIN. I was going to tell you, Alexander, that in one country alone, is it found as you wish to find it, and that country is Prussia, which possesses the only mines of amber at present

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known: they are worked in the usual way, to the depth of about one hundred feet. The amber is imbedded in a stratum of fossil wood, and occurs in rounded pieces, from a few grains to three or even five pounds in weight. The largest piece of amber ever known to be discovered, was found near the surface of the ground, in Lithuania, about twelve miles from the Baltic Sea. It weighed more than eighteen pounds, and was deposited in the cabinet of the king of Prussia, at Berlin.

ALEXANDER. That is something like doing business; but to pick it up piecemeal on the sea-shore was such a pitiful way of procuring it. How long has amber been in use?

MISS ANGERSTEIN. The Greeks and Romans were well acquainted with it, and before the discovery, or rather the dispersion of precious stones from India, amber was considered of great value as a jewel, and was employed in all kinds of ornamental dresses. Under the Emperor Nero, persons were sent from Rome for the purpose of collecting and purchasing amber; and so much of it was at length obtained, that it was used for ornamenting the nets and cordage employed in the amphitheatre, for preventing the wild animals from approaching the populace assembled there. It was likewise used to ornament the armour, the biers, and funeral apparatus of such persons as were killed.

ELIZABETH. And for what is it now used?

MISS ANGERSTEIN. After having been roasted,

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or melted, amber is readily soluble in oil, and in this state constitutes the basis of several kinds of varnish. It is also occasionally manufactured into snuff-boxes, bonbonnieres, small vases, necklaces, bracelets, caneheads, and other ornamental articles, many of which are purchased by the Turks, Russians, and Poles; but the general demand for them has very much decreased. There are, however, still considerable manufactories of amber at Stolpen, Konigsberg, Dantzic, and Lubeck. There is one property belonging to this substance, which I had nearly forgotten to mention.

EMILY. Oh! pray tell us what that is.

MISS ANGERSTEIN. That amber becomes strongly electric by friction, when it has the property of attracting light bodies; for which reason an ancient Greek philosopher attributed to it a certain kind of life.

EMILY. How I wish I had a piece of amber to try!

MISS ANGERSTEIN. You may try the same thing with a stick of sealing-wax, as you have no amber. It will act exactly in the same manner if well rubbed. Now then for the other acid.

ALEXANDER. Which I hope may lead to some account equally interesting with that of amber.

MISS ANGERSTEIN. The *mellitic* acid is procured from a mineral substance, which was discovered about the year 1790. Werner gave it the name of *honegstein* (honeystone) from its colour: by other mineralogists it has been denominated *mellite*, from

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the Latin name of honey, and hence the acid which this mineral affords has been called the mellitic acid. Mellite or honigstein, appears to be of vegetable origin, as it is found in small crystals, among the layers of wood coal, at Arten, in Thuringia, and in Switzerland, accompanied with mineral pitch, and is as yet a very rare mineral.

ALEXANDER. And so end the acids. Now we have dóne with them all.

MISS ANGERSTEIN. With all that are generally considered necessary to the study of mineralogy; but I believe there are thirty-four acids already known, and the number is constantly increasing.

ALEXANDER. Then by the time I take a fancy to the study of chemistry, the number may be so large that I shall be sadly alarmed with the length of the list I shall have to commit to memory.

JEAN. Silly boy! Now do be quiet, and let us go on to the next in the list of the constituents of minerals, which I think is *phosphorus*.

MISS ANGERSTEIN. Phosphorus is a simple substance that was formerly unknown. It was accidentally discovered in 1677, by an alchemist of Hamburgh, named Brandt, when he was engaged in searching for the philosopher's stone; but the method of obtaining it remained a secret, till it was a second time discovered, both by Kunchkel, a German chemist, and Robert Boyle, the celebrated natural philosopher, in the year 1680. Mr. Boyle communicated the process to Godfrey Hanhuritz, an apothecary of

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London, who for many years supplied all Europe with phosphorus, and from this circumstance it went under the name of English phosphorus. Phosphorus is a combustible substance, and when pure, somewhat resembles bees' wax, both in colour and consistence; when exposed to the air, under the usual temperature of our atmosphere, it is luminous in the dark, and has a smell somewhat resembling that of garlic. It is so combustible, that when cut, or melted, it should be kept under water, as it cannot be exposed to the air during this process, without great risk of catching fire. It is not known in a native state; the whole of what is used in philosophy and commerce, being obtained by different artificial processes. The greater part is procured from bones.

ELIZABETH. From bones! What, do our bones contain phosphorus?

MISS ANGERSTEIN. Yes, my dear: it was not till the year 1774, that the important discovery of phosphorus being contained in the bones of animals, was made by two Swedish chemists, named Gahn and Scheele.

ALEXANDER. I have a box of phosphoric matches at Eton. They, I suppose, are prepared from this substance.

MISS ANGERSTEIN. Certainly: When melted, phosphorus combines with a great variety of substances. With sulphur it forms a compound so extremely combustible, that it immediately takes fire on coming in contact with the air. It is with this

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composition that your phosphorus matches are covered.

JEAN. You said phosphorus was discoved by an alchemist, when he was searching for the philosopher's stone: what are alchemists?

MISS ANGERSTEIN. About the tenth century, or perhaps earlier, a set of men arose, and continued to flourish till the sixteenth, who assumed, by way of distinction, the name of *al chemists*, that is, *the chemists*, because they considered themselves, on account of the knowledge they possessed, more highly favoured than the rest of mankind. The immediate object of their pursuits was transmutation of the baser metals into gold.

JEAN. What then was the philosopher's stone Brandt was in search of? Why was he different from the rest, in preferring a stone to gold?

MISS ANGERSTEIN. His labours and researches all tended to the same end. He was endeavouring to discover a substance possessed of the wonderful property of converting the baser metals into gold, and this celebrated substance was denominated the philosopher's stone.

ALEXANDER. Thank you, ma'am, for this explanation; for I did not rightly understand before about the philosopher's stone, any more than Jean, though I was aware that alchemists were always endeavouring to procure gold by chemical preparations. Now we go on to *fluorine*.

MISS ANGERSTEIN. That will not occupy us

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long, as it has not yet been seen in a simple or separate state, but, combined with lime and alumine, forming various species of fluor.

ALEXANDER. I call that an unsatisfactory article, and will now enquire about *nitrogen*.

MISS ANGERSTEIN. This has been obtained only in the form of a gas. It immediately extinguishes flame, and is fatal to animal life, which can only be maintained by oxygen gas, or by gases which contain it; yet it constitutes a very large proportion of the atmospheric air.

ELIZABETH. And yet you say it is fatal to animal life.

MISS ANGERSTEIN. And so it is, my dear, in its pure state; but in the atmospheric air it is combined with oxygen, (which I have before explained to you,) in the proportion of seventy-eight parts of nitrogen, or azotic gas, to twenty-two of oxygen gas.

ALEXANDER. Then, when we breathe, do we inhale the nitrogen as well as the oxygen?

MISS ANGERSTEIN. Most assuredly we inspire them both at the same time. It is supposed that the nitrogen is respired from the lungs, without any change or diminution, while a small portion of the oxygen is retained, which serves to stimulate the heart, and keep up its muscular motion. But as I do not wish to enter upon this subject with you at present, we will just take notice of the two last in the list, and then we shall have completed our preliminary observations, which have occupied us much

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longer than I had intended; but it is partly your own faults, for requiring so many stories, descriptions, &c. to illustrate the subject.

JEAN. But that is the part which is the most amusing, and which I, for one, should be very sorry to have curtailed. Therefore I do hope you will be so good as to go on in the same way, and make the remainder as interesting as you have done the first part.

MISS ANGERSTEIN. I will try what I can do to oblige you. You must, however, bear in mind, that I do not mean these conversations should supersede all futher enquiries into this interesting study. I only wish to give you a general idea of the four great divisions or classes, in the hope of awakening in you a taste for admiring and examining the wonderful productions of nature, and of leading your minds to the consideration of that great and good Being, who has so munificently provided, not only for our wants, but also for our pleasures. Nothing tends more to elevate the thoughts to God, than the study of nature; for who can reflect upon the least of his works, without being convinced of his omnipotence?

ELIZABETH. When I consider the infinite variety of substances which the study of natural history affords to us, I am almost in despair; for the longest life and the clearest intellects would not suffice to become acquainted with them.

ALEXANDER. It is impossible, Elizabeth, for any

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one person to become intimately acquainted with every branch of human knowledge. Therefore it is very happily ordered that tastes should differ, some being inclined to one pursuit, some to another; and those idlers (like you and I) who are not gifted with talent for any one study in particular, should sip the honey which the more industrious have collected for us.

Miss Angerstein. You, Alexander, who have received from your Creator a capacity superior to many other boys—who have also the opportunity of improving it placed within your reach—ought not to be satisfied with merely sipping the honey, (as you express it,) but should resolve to trace knowledge up to its fountain head. I do not like to hear you speak of taking things so easily and idly. You have talents bestowed upon you, and you are accountable for their improvement and right use, to your Heavenly Father who has so liberally gifted you.

Alexander. I am very fond of reading, I aasure you; but some how or other, I am not much the wiser for it. After reading for two or three hours, (as I frequently do in a winter's evening,) I get up from my book without retaining scarcely any thing of what I have read. I have been amused, and my time passed away pleasantly; but I do not find I add much to my stock of knowledge, by the many hours I spend in that way.

Miss Angerstein. What you complain of is

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very easily accounted for, my dear boy; and I can as easily point out a remedy for it, which, if you steadily put in practice, will render your reading not only amusing, but profitable. You now read without reflection, consequently your ideas become the more confused the greater number of books you skim over: instead of obtaining knowledge and information, your understanding is weakened, and you gradually acquire a multitude of false ideas.

ALEXANDER. It is so indeed. But now for the remedy.

MISS ANGERSTEIN. Always read with the greatest attention; weigh well and seriously the reflections and judgments of the author: and recollect, that this point is of the very greatest importance, for by adopting this habit of meditating upon the sense and meaning of a writer, reading will truly form your heart and understanding.

ALEXANDER. But the difficulty is to fix the mind upon the subject before you. When I am seated reading at my desk at Eton, my mind is often with you all at Inch Cairn, and then of course I am not much the better from the many pages I have turned over.

MISS ANGERSTEIN. Nothing can be done without a fixed and determined resolution; but with it, you may easily overcome this idle disposition. Dr. Watts, in his excellent work upon the "Improvement of the Mind," has some very useful observations upon the proper method of reading, which I think might

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be serviceable to you, Alexander. Therefore, we will quicken our pace a little, that we may have time to read them over before breakfast; and if you will promise me to give them a fair trial, I shall have much pleasure in copying them out for you.

ALEXANDER. You are too good to me; but till I know what they are, I cannot promise to adopt them. This much, however, I will say, that as you have taken the trouble to point out both the cause of, and the remedy for my complaint, I should be most ungrateful did I not endeavour to cure it; and I must do as you recommend, summon up a fixed and determined resolution. Now then for *chlorine* and *boron*.

JEAN. Oh, yes: these are the two last on the list to be explained; and then we shall proceed to those great classes, you know, Alexander, which you compared to the four provinces of Ireland.

ALEXANDER. Might I not, with some justice, now say, be quiet, silly girl, and let us go on?

Jean's colour rose at her brother's speech, and she was just going to make a very sharp reply, when the gentle Elizabeth, taking hold of her hand, pressed it kindly. This sign of friendship had been agreed on between the two sisters, as a likely method of checking Jean's impetuosity, and in the present instance it had an instantaneous effect. Her lip was quivering with anger, but instead of giving vent to her feelings, she quietly returned the pressure of her sister's hand, and looking affectionately at

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her, she brushed away a tear which her suppressed emotion had forced into her kindling eye.

Miss Angerstein perceived Elizabeth's motive for, and Jean's proper reception of, this act of kindness, and could not but feel gratified at the effect her daily and hourly instructions seemed to be taking on the minds of her young charge. She was sensible of the great advantage she possessed, in having for her eldest pupil one so well inclined and amiable as Elizabeth. Many elder sisters are not aware of the responsibility of their situation, but Elizabeth had been made fully so by her kind instructress. She knew how important it was for her to behave well and conduct herself with propriety, that she might serve as an example to her younger sisters. The advice and opinion of an elder brother or sister always influence the conduct of the younger ones, and it is astonishing what a happy effect a good example may produce in a large family of children. Neither Elizabeth nor Jean are imaginary characters; they are both now living, and are blessings to their families and friends. The one having been gifted from her cradle with an amiable disposition, improved by religion; the other, naturally hasty and impetuous, but corrected by the watchful eye of instruction, founded upon humility and virtue. But to return to the young party.

After this struggle with herself, Jean quietly asked Miss Angerstein to complete the explanations, by telling something about *chlorine* and *boron*. Upon

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which she, with a smile of approbation, offered Jean her arm, and continued as follows.

MISS ANGERSTEIN. They will not detain us long, my dear Jean. Chlorine has never been found pure in nature, and its claim to be considered a mineral constituent rests on its being the base of the muriatic acid, which enters largely into the composition of rock salt, and in less proportion is found in combination with lead, silver, and quicksilver; but is not found in any earthy mineral.

ELIZABETH. Boron will, I hope, afford you more to say about it; for chlorine is certainly one of Alexander's unsatisfactory articles.

MISS ANGERSTEIN. Boron is still less satisfactory, as it is a substance not completely understood; but it is ascertained to be a substance differing from every other known species of matter. Combined with oxygen in the form of boracic acid, it is found in combination with the earths, magnesia and lime, in a few rare minerals, and with soda, forming borax; but it has not yet been detected in any metalliferous substance. I have now finished all I mean to say upon the elements of minerals, as the bases of the *tungstic*, *molybdic*, *chromic*, and *arsenic acids*. Tungsten, molybdina, chrone, and arsenic, being metals, we shall speak of them when we come to the fourth class. Those of the carbonic and sulphuric acids will be noticed when we speak of inflammable minerals.

ALEXANDER. Then, as we are now at home, may

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I run in for the book you mentioned? I think there will be time before breakfast to read the rules; will there not?

Miss Angerstein. Yes, plenty of time; for they are very concise, considering the importance of the subject. You will find in my book-case, a small edition of "Watts on the Improvement of the Mind." I have marked some passages which I thought particularly useful, and shall be able to point them out to you easily.

Alexander. But you did not think of me when you marked them.

Miss Angerstein. Certainly not, for I was then totally unacquainted with you; but it has always been my practice, when reading my own books, to mark such passages as seemed likely to be hereafter useful to me: when books belong to others, I extract them, and make them my own in that way. Now fetch the book, for time flies.

Alexander soon returned, and putting the book into Miss Angerstein's hand, looked over her while she read as follows.

"It is of vast importance for the improvement of knowledge, that a young person should have the most proper books for reading, recommended by a judicious friend.

"In books of importance, I would advise that the preface be read, and a survey taken of the table of contents, (if there be one,) before the first perusal of the book. By this means you will not only

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be better fitted to give the book the first reading, but will be much assisted when reading it the second time, which should be done with still greater attention and deliberation. Unless a reader has an uncommon and most retentive memory, I may venture to affirm, there is scarcely any book or chapter worth reading once, that is not worthy of a second perusal.

" Remember, that your business in reading, especially on subjects of natural, moral, or divine science, is to consider whether the opinions of the author are just, and to increase your own knowledge on that subject, by meditation on the heads of their writings.

" Let this, therefore, be your practice. If a writer does not explain his ideas well, mark the faults, and endeavour to do it better in some papers of your own. For instance: where the author is obscure, enlighten him; where he is too brief, amplify a little, and set his opinions in a fairer view; where he is redundant, mark these paragraphs to be retrenched; where he argues, observe whether his reasons are conclusive; where you suppose he is in a mistake, propose your objections, and correct his sentiments; what he writes, that your understanding approves both as just and useful, treasure up in your memory, and count it a part of your intellectual gains.

" This method of reading will cost some labour at first, but the profit will richly compensate the

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pains: one book read in this manner will more enrich your understanding, than skimming over the surface of twenty authors."

ALEXANDER. What a laborious task this quaint gentleman proposes! a twelvemonth would not suffice to get through a small volume.

MISS ANGERSTEIN. But one small volume so read, would effectually cure your complaint. Your mind would become accustomed to fix steadily upon the subject, and your reading would then strengthen your faculties, and you would be surprised at the quantity of really useful knowledge acquired in a comparatively short space of time. I have now given you the remedy, the application of it must depend upon yourself.

ALEXANDER. I must not make rash promises, because I might not steadily keep them; yet, if you would be kind enough to give me a copy of those rules before I return to Eton, I will try their effect for a short time, at any rate.

MISS ANGERSTEIN. Remember that nothing can be done without patience and perseverance. Adopt the fixed determination to cure yourself of this bad habit, and allow nothing to turn you from it. Abstain for a time from all light reading, of which I know you are but too fond, and confine yourself to historical reading, which, from interesting the mind by a variety of sensible occurrences, tends strongly to fix the attention. Voyages and travels may be your books of amusement, but even these must not be

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skimmed over. You must frequently stop, and recall what you have read, that you may be sure your attention has not wandered from your subject. It is now so near breakfast-time, that we must be quick.

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CHAPTER VII.

Miss Angerstein being down a little while before the young people were quite ready for prayers, had occasion to go to the work-drawer, which she found in great confusion and very untidy. She was grieved to see it so, because, having placed it under Elizabeth's peculiar care, as a means of curing her of a habit of procrastination, which she was but too much inclined to give way to, it was a proof the fault though checked, was not eradicated. So soon, therefore, as the first duties of the morning were over, and before they took their walk, Miss Angerstein called Elizabeth's attention to the drawer.

"In the hope of strengthening in you the habits of order and regularity, Elizabeth, I gave you the charge of keeping the work tidy. I am vexed to see it in this state, mostly unfolded, and absolutely pushed in in such disorder, that, when once shut, it was a difficult matter to get the drawer open again."

Jean. I put that piece of work in: I was rather late last night, so I did not stay to fold it.

Elizabeth. I forgot to look at the drawer be-

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fore I left the study. I fully intended to do so before I went to bed; for I recollected it while we were at tea, but it again slipped my recollection. I had no idea it was so untidy, I put it so very neat two or three days ago.

While they were speaking, Alexander came running into the room, exclaiming, "Dear Elizabeth, here is another pair of gloves to mend. Have you done those I gave you a week ago?"

Elizabeth coloured deeply, and mournfully answered: "No, Alexander; but indeed I will do them for you this evening;" and was taking the other pair from him, when he said: "Oh! I must keep these then, for I have no others to put on."

Elizabeth felt so ashamed of her idleness and want of attention, that she could scarcely refrain from tears, which her brother seeing, he was quite vexed at having asked for his gloves. "Never mind, dear Liz," said he; "you will mend them this evening, and these will do very well for to-day: see, the holes are not very large."

Elizabeth continued folding up the work, and arranging the drawer. She felt thankful to her brother for his kind endeavours to console her, but her heart was too full to give utterance to words. Miss Angerstein saw Elizabeth's distress, and as this was the only point upon which she had any frequent subject of complaint, she did not wish to increase it; and forbore, for the present, to make any remarks upon it. The drawer being now set to

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rights, the whole party took their way to the cow-house. Elizabeth, knowing that she had given just cause of offence to Miss Angerstein, did not venture to take hold of her arm as usual, but walked silently by her side. Miss Angerstein kindly offered her arm, and the tears then chased each other down Elizabeth's cheek, while she gladly resumed her usual place, saying: "I do not deserve this kindness, for I have been inattentive to your wishes, and unkind to my brother."

Miss Angerstein. My object, my dear child, is your improvement, not the indulgence of my own feelings. Were I to say that I have not been angry with you this morning, I should not speak correctly. I was angry at first, though I said little; but your sorrow for your fault very soon banished that sentiment, and made me only regret, that you should have so much grief through your own negligence. It is the want of order which occasions it. Without order, many things will be improperly delayed, or wholly neglected; for order is the very parent of tranquillity and happiness.

Jean. But though order would have put the drawer tidy, I cannot see how it would have mended the gloves.

Miss Angerstein. Had Elizabeth recollected the gloves, she would have mended them. Now, had she obeyed me, and put the work properly in the drawer, she must have seen them, and would have been spared the pain of appearing unkind to

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her brother. Besides, Jean, order in your studies, exercises, and employments, gives you time for every thing, and prevents all hurry and embarrassment. By keeping every thing in its proper place, you will escape the loss of many valuable moments, and the anxiety of many unprofitable searches.

JEAN. Ah! now I understand you; for when I forget to put away my gloves, scissors, or thimble, I lose a great deal of time, which order would have saved me.

MISS ANGERSTEIN. Order and punctuality contribute greatly to the comfort of a family; therefore it is highly necessary they should be strongly inculcated on every female mind. One great reason why some people succeed so little in the art of pleasing, is their not observing proper rules of time and place. There is nothing that makes us more welcome members of society than punctuality; for people know how to depend upon us, and are sure we shall never give them the least uneasiness or disappointment, if we can possibly help it. Exactness, even in trifles, brings its reward, by securing us from many an uneasy reflection.

ELIZABETH. I do feel extremely hurt at my own misconduct, and will earnestly endeavour to convince you of my sorrow, by greater attention for the future.

MISS ANGERSTEIN. And I freely forgive you, my dear Elizabeth, and hope you will fulfil your

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promises for your own sake. You have merely trifles now to attend to, and it may perhaps seem of little consequence whether the work-drawer was looked at last night or this morning; but if young people are allowed to neglect these trifles, they will not be any more punctual when they have things of greater moment confided to their care; for a bad habit, once formed and left uncorrected, while young, will in all probability accompany them through life. Now then for our milk.

ALEXANDER. Emily and Fanny had already drank their glasses of milk, and were waiting with it for the arrival of the rest of the party, who were not long in dispatching theirs also, when they resumed their walk, and the conversation changed its subject, by Miss Angerstein's asking the young people what was the first class of minerals which they were to discuss.

"To convince you," said Alexander, "that I really did learn all those lists you gave us, I shall take the liberty of answering for the young ladies. The first class consists of *earthy minerals*—being all such as are void of taste and smell, are light and brittle; as millstone, limestone, flint or silex, clay, sand, crystal, spar, gypsum, alabaster, chalk, cornelian, jasper, topazes, sapphires, emeralds, opal, amethysts, &c.

MISS ANGERSTEIN. Very well. I must however require a further stretch of your memory, by learning that this first class contains ten genera.

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1 Silex	6 Barytes
2 Alumine or Argil	7 Strontian
3 Zircon	8 Lime
4 Glucine	9 Magnesia
5 Yttria	10 Thorina.

ALEXANDER. These I will enter both in my book and in my memory. But there is one thing I wanted to ask you ever since you gave us the classes, but some how or other I have always forgotten it; this is, why, among the precious stones you mention there, you omitted the diamond, and placed it with such things as coals, &c. in the third class?

MISS ANGERSTEIN. Till lately mineralogists always placed it among the earthy minerals; but as it does not contain any earthy particles, and is said to be pure carbon, it is now generally arranged amongst the inflammable or combustible minerals. This you will understand better by and bye.

ALEXANDER. Then I must wait patiently, and proceed step by step, and will listen while you tell us what silex is, or is not.

MISS ANGERSTEIN. Before I do that, I must make one observation which applies to all the ten earths, and is—that all these earths agree, when free of foreign admixtures, in this one character, they are all snow-white.

ALEXANDER. How very singular! Snow-white! Why flint, which is the English of the Latin word *silex*, is sometimes almost black, and constantly of a dark slate colour.

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MISS ANGERSTEIN. But common flint, though it gives its Latin name to this earth, is not pure silex. Indeed, in a state of nature, silex has never been found pure; but in combination with other substances, it abounds in almost every country of the globe. Water will not dissolve it, nor any kind of acid, except the fluoric. Sir Humphrey Davy, a very celebrated chemist and mineralogist, who lately died at Geneva, has decided that this earth is not a simple elementary body, but consists of equal parts of a substance of a peculiar nature, which he has called silicium, and of oxygen.

ALEXANDER. Do you recollect the curious way in which a letter was once directed to this said gentleman?

MISS ANGERSTEIN. I never heard of it, therefore I cannot recollect it; but perhaps you do, and can tell us what there was so curious in it.

ALEXANDER. I was so very much amused with it when I first read it, that I do not think I shall easily forget it; but if I raise your expectations so high, you will not perhaps think it so curious as I did.

JEAN. Then tell us at once.

ALEXANDER. Then lend me a pencil, Jean, and I will write it: it will appear nothing if I pronounce the words. In December, 1821, a letter was received at the Post-office with this curious direction, *(showing the paper,)*

"*Alla sua Eccellenza,*
Sromfredevi."

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As it baffled the good people there, they sent it to the British Museum, in hopes of its being explained by some of the literati; when Mr. Vansittart suggested it might be for Sir Humphrey Davy, which proved to be the case.

JEAN. It would have remained a sealed letter for any thing I could have suggested on the subject.

MISS ANGERSTEIN. And yet, when the word is pronounced, the sound greatly resembles what I can imagine a foreigner would make of his name.

ALEXANDER. I beg pardon for interrupting the conversation for the sake of telling a story; the name brought it so fresh to my memory, that I could not help speaking of it.

ELIZABETH. I hope you will be so good as to give us a description of some of the minerals belonging to each genus, because that will make the study so much more interesting.

MISS ANGERSTEIN. Well then, we will first speak of *flint*, as it gives name to the genus, and enters so largely into the manufacture of glass and porcelain, which are articles of luxury, and with which we are all well acquainted. Its property of yielding sparks, when struck against steel, has rendered it an article of indispensable utility in the system of modern warfare; and to it the sportsman also is indebted for a means of obtaining his game. The art of cutting, or rather breaking this stone into gun-flints, is of modern date, and was for a long time kept secret. The manufacture is even now chiefly confined to England and two or three departments in France;

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and the operation is so simple, that a good workman has no difficulty in making fifteen hundred flints in a day. An attempt was once made in Prussia, to substitute a kind of earthenware or porcelain for flint; and such was for some time used by the Prussian soldiers, but it was not found to answer.

ALEXANDER. What is the method made use of in preparing gun-flints?

MISS ANGERSTEIN. The whole art consists in so striking the stone with a kind of mallet, that at each stroke a splinter shall be brought off, sharp at one end and thick at the other. These are afterwards shaped, by placing them upon a sharp iron instrument, and then giving them repeated small blows with a mallet.

ALEXANDER. In this, as well as in many other things, practice must make perfect; but fifteen hundred seem a great many for one man to make in a day.

JEAN. You will tell us something about the manufacture of glass, into which you say flint enters as an ingredient or principal article. When was it discovered?

MISS ANGERSTEIN. According to Pliny, the discovery of glass took place by accident, in Syria, at the mouth of the river Belus, by certain merchants driven there by shipwreck. Being obliged to dress their victuals by making a fire on the ground, with the plant *kali*, which grew on the spot, the sand or stones of the place accidentally mixing with the

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ashes of the kali, a vitrification was undesignedly made.

ELIZABETH. But did these merchants make any use of their discovery?

MISS ANGERSTEIN. At this distance of time, nothing certain can be known concerning it, but the hint once taken was easily improved upon. According to some authors, the first place mentioned for the art of making glass, is Sidon, in Syria, which became famous for glass and glass-houses; but others maintain that the first glass-houses noticed in history were erected at Tyre. It is however supposed, that all the glass at that time manufactured was opake; as long afterwards, glass perfectly transparent was esteemed of extremely high value. It is stated that the Emperor Nero purchased two glass cups with handles, for a sum which was equivalent to fifty thousand pounds of our money.

ALEXANDER. Astonishing! He was certainly a luxurious fellow, or he would not have given such a price for things that might be demolished in an instant.

MISS ANGERSTEIN. Italy had the first glass windows, and France also had them before they were known in England. The English were obliged to have French artificers to make all the glass windows in their older churches. Most of the finest painted glass in our cathedrals came from France. Glass was at first chiefly, if not solely, employed in Italy, France, and England, for religious buildings.

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It was not used in France, in domestic architecture, till the fourteenth century, nor in England till some time later. The first glass ever seen in England was at Hexham Abbey, in Northumberland, made by some workmen from France.

ELIZABETH. I cannot imagine what they did with their windows, when they had no glass.

MISS ANGERSTEIN. They covered them with cloth in cold weather, and in warm weather with lattice-work.

EMILY. But I do not know what glass is made of. Will you be so good as to tell Fanny and me? We have been listening to all you have said about it, and I should like to know.

MISS ANGERSTEIN. Certainly, my little girl. Glass is made by mixing sand, or prepared flint, with a certain proportion of soda, or potash, and exposing these substances in a furnace to a violent heat. When they are in a perfectly fluid state, part of the melted matter is taken out at the end of a long hollow tube. The workman then blows through the tube till the melted mass at the end swells like a bubble; after which, he rolls it on a smooth surface to polish it, and repeats the blowing until the glass is brought as nearly to the size and form of the vessel required, as he thinks necessary. Should a handle, foot, or any thing of a similar kind be required, that is made separately, and stuck on in its melted state.

JEAN. But glass for windows cannot be blown in that manner, for it is flat and even.

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Miss Angerstein. It is a strong, and a wrong assertion, my dear Jean, to say it cannot be done; for window-glass is made in an exactly similar manner, except that the mass at the end of the tube is blown into a cylindrical shape, which being cut down by scissors, or rather shears, is gradually bent back until it becomes a flat plate.

Jean. I do think this will cure me of saying things can or cannot be; for how could I have suspected that window-glass was blown like a bottle or decanter!

Miss Angerstein. The only way to cure yourself, Jean, is to set a watch upon your lips, and to have a humble opinion of your own judgment and acquirements. At your age it is impossible to form correct ideas upon subjects with which you are totally unacquainted; therefore the best thing for you, is to ask whether such and such things are or are not so, instead of asserting that they cannot be. I hope I shall not hear you say so again for a long time to come.

Elizabeth. Last winter some very handsome tumblers, that papa ordered from Edinburgh, cracked immediately that warm water was put into them; and mamma said they had not been properly *annealed*. What did she mean?

Miss Angerstein. All glass utensils, unless very small and thin, require to be gradually cooled in an oven, and this operation is called *annealing*. It is necessary, in order to prevent them from cracking

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by change of temperature, wiping, or slight accidental scratches.

ALEXANDER. Plate-glass is not blown, I believe: I think I have heard that it is run.

MISS ANGERSTEIN. You are quite right. Large plate-glass, for looking-glasses and coach-windows, is made by suffering the mass, in a state of complete fusion, to flow upon a casting-table with iron ledges. These confine the melted matter, and, as it cools, a metallic roller is passed over it, to reduce it to an uniform thickness. The Venetians, for many years, excelled all Europe in the fineness and size of their looking-glasses; but they are now surpassed both by the French and English. Mr. Townsend, who travelled through Spain in 1786, mentions, in the second volume of his journey, that the glass manufactory at St. Idlefonso, (a noted palace built by Philip the Fifth, about twenty-four miles from the famous Escurial,) is carried to a degree of perfection unknown to the rest of Europe. The largest mirrors are made in a brass frame, one hundred and sixty-two inches long, ninety-three wide, and six deep, weighing nearly nine tons. These are designed wholly for the royal palaces, and for presents from the king.

ELIZABETH. When did England begin to manufacture glass for itself?

MISS ANGERSTEIN. Not till the year 1557. It was improved in 1635, and brought to a great degree of perfection in the reign of William the Third;

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but the first glass plates for looking-glasses and coach-windows, were made in 1763, at Lambeth, a large village adjoining London.

EMILY. When I write well enough, may I have a book to put all you tell us into? I think I should remember it better, and have nearly a book full at the year's end.

MISS ANGERSTEIN. If you take great pains with your writing till New Year's Day, I will then give you such a book as you want, ruled for round hand; in which you may enter all you recollect of our conversations, upon this condition, that you never scribble, but write as well as you can.

EMILY. Oh, thank you, ma'am! thank you! How very good that is to let me have it so soon. You shall see what pains I will take. I have done better lately, have I not?

MISS ANGERSTEIN. Or I should not have made you this promise, because you would have deserved no encouragement. When I see you try to do right, I always seize the first opportunity of rewarding you for it.

EMILY. When I get my book I shall put glass as the first article, I have been so much interested with your account of it.

MISS ANGERSTEIN. All the precious stones, diamond excepted, belong to this genus. I think it would be as well to give you a list of some of the principal minerals contained in it, and then, when you have read it over, you can ask me what questions you please about any of them.

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ALEXANDER. That is exactly what I should like.

MISS ANGERSTEIN. Here it is then. It must be entered.

SILICIOUS GENUS.

Mountain Crystal	Chrysolite	Jasper
Quartz	Obsidian	Heliotropium
Amethyst	Shorl	Woodstone
Emerald	Tourmaline	Elastic Quartz
Beryl	Lapis Lazuli	Felspar
Ruby	Opal	Moonstone
Topaz	Pitchstone	Labrador Stone
Saphire	Calcedony	Silicious Spar
Garnet	Onyx	Agate
Emery	Cornelian	Common Sand
Chrysoberyl	Cat's Eye	

ALEXANDER. I shall have such numbers to enquire about, that I am afraid I shall tire you.

EMILY. Stop, dear Alexander. May I ask Miss Angerstein one little question, before you begin your string of enquiries?

ALEXANDER. Yes, certainly; your little questions deserve as much attention as mine; therefore you have my leave to ask it immediately.

EMILY. In Mangnall's "Miscellaneous Questions," I learnt that emery was a rich iron ore, found in large masses, extremely hard and heavy, &c. and yet you have just given my sisters a list of the flinty genus of earthy minerals, among which is emery. Now I thought it was a metal, from having learnt it was a rich iron ore.

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MISS ANGERSTEIN. It was formerly always classed among the iron ores, and is still so classed by some few mineralogists, though it is now generally allowed to be an earthy, not a metallic mineral. It is so hard a stone, as nearly to equal adamantine spar.

EMILY. I am glad what I learnt was not absolutely wrong. Where does this hard mineral come from?

MISS ANGERSTEIN. The best emery comes from the Levant, which is, (as I hope you know,) the coast on the eastern part of the Mediterranean Sea. A great quantity comes from Nascos, and other islands of the Grecian Archipelago, where it occurs abundantly, in large loose masses, at the foot of primitive mountains. It is also found in some parts of Spain, and is obtained from a few of the iron mines in our own country.

ELIZABETH. What do you mean by *primitive mountains?*

MISS ANGERSTEIN. Geologists have divided mountains, or rocks, into primitive, transition, and floetz. Primitive mountains are so named, because, so far as is known, they are the oldest, and were the first formed, for they never contain animal remains, nor do they ever rest upon those rocks which enclose animal remains.

ALEXANDER. I never learnt Magnall's Questions, therefore I should be glad if you would tell me a little of the different uses to which emery is applied.

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Miss Angerstein. It is employed by lapidaries in the cutting and polishing of precious stones; by opticians, in smoothing the surface of the finer kinds of glass, preparatory to their being polished; by cutlers, and other manufacturers of iron and steel instruments; by masons, in the polishing of marble; and by locksmiths, glaziers, and numerous other artisans, in their respective businesses. For all these purposes it is pulverized in iron mortars, or in steel mills, and is afterwards separated, according to the several degrees of fineness that are required, by washing it several times in water, and suffering the grosser particles to deposit themselves. By these successive operations the emery is reduced to so fine a powder, that when rubbed between the fingers, it communicates no sensation whatever of grittiness.

Alexander. I one day went into Tangier mill, and finding the miller a very chatty fellow, I asked him many questions, and among the rest, where he got the millstones from, and he told me they were French stones. Do you think that was true?

Miss Angerstein. I see no reason to doubt it, Alexander; nor will you, when you have heard what I am willing to tell you about millstones.

Alexander. I am sure I am willing to listen and learn, if you will be so good as to speak; so do tell us what sort of stone is used for such purposes.

Miss Angerstein. A coarse variety of quartz, commonly called burrstone, which is chiefly found in

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France; but is so much esteemed by English millers, that the Society of Arts, in London, for many successive years, offered a considerable reward for its discovery in Great Britain. At length a vein of burrstone was discovered in the Noel y Golfa Hills, in North Wales, by a Mr. Evans, who, in consequence, received a premium from the Society. About the same time another vein was opened near Conway; and the same society, in the year 1800, gave a premium to the widow and orphan children of the discoverer, of one hundred pounds. Both these quarries were sufficiently convenient for water carriage; yet the demand for the Cambrian burr did not answer the expectation, and millstones of French production are still preferred.

ALEXANDER. Then my friend, the Eton miller, was very likely correct in his story. Through my own ignorance I almost fancied he was making a joke of me.

MISS ANGERSTEIN. You should have sought an explanation, either from books or from some one acquainted with the subject, and not remained contentedly in your ignorance. The method of splitting these stones, as it is practised in some parts of France, is so singular, that I must not omit telling you of it.

EMILY. Oh! pray tell us little ones too.

MISS ANGERSTEIN. I have not the least objection to you little ones listening to what we great ones talk about, if you find any amusement from it, provided you do not whisper to each other, so as to in-

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terrupt. Whenever you are tired, run away and play about. Now Alexander listen, and do not pull Jean's hair.

ALEXANDER. I am all attention. I was only amusing myself while you and the little ones settled matters; and there is really some comfort in teasing Jean a little bit now, she takes it all so good-humouredly. I declare, Jean, I love you ten times better these holidays than I ever did before—you are so much better tempered.

MISS ANGERSTEIN. And as a proof of your love, you pull her hair.

ALEXANDER. Oh, not to hurt her; merely to play with her. But will you not tell me how they split the French millstones?

MISS ANGERSTEIN. With pleasure, if you will listen. The blocks of burrstone are first cut into the form of cylinders, sometimes many feet in height. To split these horizontally into millstones, circular indentations are made round them, at proper distances, according to the thickness that is to be given to the stones; wedges of willow that have been dried in an oven, are then driven into the indentations with a mallet. When these have been sunk to a proper depth, they are moistened with water, and after a few hours, the several stones that have been marked out, are found to be perfectly separated.

ELIZABETH. That is most singular indeed! To what can it be owing that the willow separates the stones?

MISS ANGERSTEIN. To capillary attraction.

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ELIZABETH. But as I never before heard of *capillary attraction*, I am now as wise as ever, and must come to you for an explanation.

MISS ANGERSTEIN. The ascent of water, or other liquids, in sugar, sponge, or other porous bodies, is called capillary attraction, from *capillus*, the Latin word for hair. It is thus named from the property which tubes of a very small bore, (scarcely larger than to admit a hair,) have of causing water to stand above its level. Willow being a very porous wood, absorbs the water, and by the swelling of these wedges the stones are split.

ELIZABETH. I now clearly understand the process: whoever first thought of it must have been very ingenious.

JEAN. What is that elegant little vase made of, which stands on the top of mamma's cabinet? It is a stone of some kind, is it not?

MISS ANGERSTEIN. Yes, my dear; it is a species of quartz called *aventurine*, and is found in some of the countries bordering upon the White Sea—in Spain, and in some parts of France. In the late Leverian Museum, there was a piece which weighed nearly five pounds, and was unique both for beauty and magnitude. It had been discovered in 1788, amongst the ruins of the triumphal arch of Julius Cæsar, in the valley of Suse, in Piedmont; and was purchased of the person who found it for two hundred guineas. This stone obtained its name from the following circumstance. A French artist, some

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years ago, having by accident, or *par aventure*, suffered a quantity of brass filings to fall into a vessel of melted glass, afterwards found it was admirably calculated for vases, and different kinds of ornamental work; he therefore called this substance *aventurine*, a name which mineralogists have since applied to all those natural objects, of which this production of art was an apparent imitation.

ALEXANDER. Then perhaps mamma's vase, by which she sets so much store, is only an imitation, in which case it is of comparatively little value.

MISS ANGERSTEIN. I do not pretend to understand the subject sufficiently to decide this point; but your mamma told me one day, that Mr. Macpherson, who is, as you must have heard, a very good mineralogist, assured her it was made of the real Spanish aventurine.

ALEXANDER. Then mamma may still value her pretty vase; for from such authority as Mr. Macpherson there is no appeal. I have so many things to ask you about, I do not know which to begin with. Oh! now I recollect: I wanted to know where you would place our national stone, the Cairn Goram.

MISS ANGERSTEIN. Among the rock crystals, my dear boy, which all belong to the quartz family, and are found in the form of six-sided prisms. Cairn Goram crystals are obtained in various parts of Scotland; but particularly from a mountain of that name in Aberdeenshire. They are usually of smoky yel-

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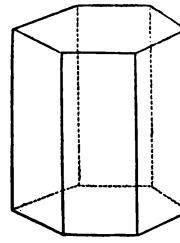
low, or brown colour, and are in so much request for ornamental articles of dress, that several lapidaries have settled in Aberdeen, who are constantly employed in cutting them for trinkets of all descriptions. When they are clear, large, and of a deep and good colour, (like the one your mamma gave me in a brooch the other day,) they are nearly as valuable as topazes.

JEAN. I have not asked one question yet about the list. May I beg you to tell me what *woodstone* is?

ELIZABETH. But before we begin another subject, I should like to know what you mean by a six-sided prism.

MISS ANGERSTEIN. Lend me a pencil, my dear, and I will show you.



ELIZABETH. Thank you, ma'am: that must go in my book.

MISS ANGERSTEIN. Now, Jean, I will answer your question. Woodstone is a very hard mineral substance, supposed to have been wood petrified with a silicious mineral called *hornstone*. It is of various

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colours; and has not only the external appearance, but the internal organization of wood. It occurs in various parts both of Europe and Asia. It has been found in ferruginous sand, near Woburn, in Bedfordshire, and near Nutfield, in Surrey. Immense pieces of it are discovered in some places, in the original shape of the trees, trunks, branches, and roots. In the year 1752, the whole under part of the trunk of a tree, with its branches and root, was found in a state of woodstone, near Chemnitz, in Saxony; and in the Electoral Cabinet at Dresden there is part of the trunk of a tree from the same place, which measures five feet in length, and nearly as many in thickness.

JEAN. Does the outside of it look like a tree, or like stone? and what colour is it?

MISS ANGERSTEIN. The surface is rough and uneven, and sometimes striped: when broken, it generally exhibits the fibrous texture of wood, and is sometimes splintery. The most common colour is dark gray, ash-gray, grayish white, and occasionally cochineal, and even blood red. Different colours appear in the same piece of mineral, forming spots, clouds, or stripes. I never saw but one piece of this stone, which was grayish white: the bark of the tree was exactly represented, and it appeared to be some kind of fir.

ELIZABETH. Where was it found?

MISS ANGERSTEIN. Upon Sir Edward Smith's estate of Newlands, about four miles from Wakefield, in Yorkshire, in a pit of sandy loam, and was con-

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sidered so great a curiosity, that lady Smith placed it in her ornamental grounds.

ALEXANDER. Is woodstone of no use?

MISS ANGERSTEIN. It is in considerable request with lapidaries, for it takes a good polish, and is made into beads for necklaces, and other female ornaments. In the East Indies it is generally called petrified tamarind tree.

ELIZABETH. You said the woodstone you saw was found in sandy loam; I have heard papa, when speaking to the gardener, about compost for the orange-trees, desire him to procure some loam, but I never knew what it was: I now suppose it must be a kind of earth.

MISS ANGERSTEIN. What a pity it is, my dear Elizabeth, that you allow so many opportunities of obtaining information to pass by you unimproved. How gladly would your papa have answered your question, had you asked him at that time what loam was. I have a great inclination not to tell you now, but to give you some books, and make you search it out yourself.

ALEXANDER. But then you will punish the innocent with the guilty, and Jean and I shall suffer; therefore, for our sakes, I must beg you to answer her question, and I dare say she will ask another time.

MISS ANGERSTEIN. I hope she will, for it prevents her obtaining much useful information. As you and Jean wish to know what loam is, I suppose

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I must look it over for this time; but I fear the habit has been so long indulged in, from indolence, that it will require some stronger incentive than even the wish to oblige me, before it will be conquered.

ELIZABETH. I do wish I had a little more curiosity in my composition, it would wonderfully help me on in the road to knowledge. But when I hear things mentioned for the first time, I seldom take any notice of them, till something occurs to bring them again to my mind: this was the case with loam. I heard papa speak of it; but I thought nothing more about it, till you mentioned it just now. I will, however, endeavour to be more on the *qui-vive* for the future, if you will be kind enough to look it over this once. You shall see that the wish to oblige you, to whom I owe so much, is a sufficiently strong motive to urge me to exertion.

So saying, she affectionately kissed Miss Angerstein's hand, and her peace was made.

MISS ANGERSTEIN. Loam is a yellowish, or brownish kind of clay, (belonging to the next genus we shall speak of, viz. allumine, or argil,) sometimes containing a considerable portion of sand. It occurs in immense beds, and is found in almost every part of the world.

ALEXANDER. Of what use is it?

MISS ANGERSTEIN. When mixed with straw, or hair, to prevent it from cracking, it is extensively used for the building of what are called mud cottages,

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or houses, which are generally reared on a foundation of stone, or brick-work, to secure them from injury by the moisture of the earth. To form the loam into bricks, and to dry them in the shade, and afterwards in the sun, is said to be the most advantageous way of using it. Such bricks are of great antiquity, as the ancient city of Damascus, and even the walls of Babylon, are said to have been constructed of bricks made of loam.

JEAN. We read in the Bible about the onyx; what sort of stone is it?

MISS ANGERSTEIN. It is a kind of calcedony, (a species of quartz,) generally marked alternately with stripes of white and black, or white and brown. The name *onyx* is derived from the Greek, and has been given it on account of its resemblance in colour to the whitish band at the base of the human nail. There is but little difference between the onyx and sardonyx, and both kinds are highly esteemed by lapidaries, for the formation of vases, snuff-boxes, &c. The celebrated Mantuan Vase is made of this stone.

ALEXANDER. Oh! pray tell us about it.

MISS ANGERSTEIN. It has obtained the name of the Brunswick Onyx, from being preserved in the Brunswick Museum. It is an antique gem, which has puzzled the learned scarcely less than the Portland Vase, which I described to you some time ago. The stone is about half a foot long, but it has been shaped into the fashion of a vase, with a golden rim and handle. The ground colour, a very deep

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brown, is varied with patches of white, some clouds of a dim yellow, and still fewer of a dark gray. At about two thirds of its depth from the mouth, it is divided by a circular band of gold, and both the upper and lower compartments are filled with figures, cut in bas-relief, in a style which has made the gem be universally considered as Grecian. It has generally been supposed to refer to the Eleusinian Mysteries; but one of the directors of the Museum thought it represented some other mysteries, celebrated in honour of Ceres, and that it was an Egyptian work, executed in the time of the Ptolemies.

EMILY. What were the Eleusinian Mysteries?

MISS ANGERSTEIN. A great festival, observed every fourth year, by many of the Grecian States, but more particularly by the people of Athens, at Eleusis, in Attica, sacred to Ceres and Proserpine. I shall not enter into any detail concerning them, as you may by and bye read an account of them in "Baldwin's Pantheon." My little Fanny has long had her lips prepared to speak; but like a good girl, she would not interrupt us. What do you wish to say, my love?

FANNY. That pretty ring you sometimes wear, which your sister brought you from France; is that a precious stone?

MISS ANGERSTEIN. My dear sister brought me three rings from France; one set with turquoise, one with rubies, and the stone in the other is opal. Which of them do you mean?

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FANNY. Let me see: turquoise is blue, and a ruby is red; now the one I mean changes colour, and is not of any one colour exactly, so I suppose it must be the one you call *opal*, though I never heard that name before.

MISS ANGERSTEIN. From your description you must mean opal, as that is a semi-transparent kind of stone, of a milky cast, which exhibits a changeable appearance of colour.

EMILY. Is it reckoned among the precious stones.

MISS ANGERSTEIN. It is, my dear; but is considerably less hard than most other precious stones. Yet its value is such, that a fine oriental opal is considered worth about twice as much as an oriental sapphire of the same size. By the Turks they are so peculiarly esteemed, that a fine opal of moderate size, has sometimes been sold at the price of a diamond. The value in which they were held among the ancient Romans was such, that Nonius, a Roman senator, is stated by Pliny to have preferred banishment to parting with a favourite opal, which Mark Anthony was anxious to possess.

FANNY. I do admire the stone very, very much; but if I had one, I had rather give it up than leave my own dear Scotland. Is yours an oriental opal?

MISS ANGERSTEIN. Indeed, my love, I cannot say. It has been very greatly admired as a beautiful stone; but from whence it originally came I know not. It is of less value to me for its beauty, than for

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its being the gift of an affectionate and deservedly beloved sister. Opals are found in several parts of Europe, and in the Island of Sumatra, and several places in the East Indies; but the only opal mines in the world are those of Hungary. About four centuries ago, opals were obtained in such abundance from these mines, which are situated in a hill of some miles in extent, at the village of Czerwenitza, not far from Caschan, in Upper Hungary, that upwards of three hundred persons were employed in them.

Emily. But the opals procured from these mines could not be the valuable specimens you mentioned, as being worth twice as much as a sapphire of the same size, because you called them oriental, and therefore I suppose they must have come from the East Indies.

Miss Angerstein. The epithet *oriental* is given by lapidaries to the more perfect precious stones; it is a term expressive of their value rather than of their origin, and is not to be understood as denoting that the precious stones have been brought from the eastern countries; but that the best gems, from whatever part of the world they are brought, are always so denominated.

Jean. We may as well know where the rubies come from that are in the hoop your sister gave you, if you will be so good as to tell us.

Emily. And the turquoise too, that are in the other ring—those pretty blue stones.

Miss Angerstein. I must first answer Jean's en-

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quiry about the ruby, and then you and I will talk about the turquoise. The *ruby*, my dear Jean, is imported into this country from the East Indies, though seldom in a rough state, as the stones are almost always first cut by the Indians, for the purpose of ascertaining their value. They are said to be found in the sand of certain streams near the town of Sirian, the capital of Pegu, and with sapphires in the sand of the rivers of Ceylon.

FANNY. Now I want to hear about my favourite stone the *turquoise*. Do you know why it is my favourite?

MISS ANGERSTEIN. No indeed, my love, I cannot guess even.

FANNY. Then I will tell you. My dear godmamma gave me a gold chain, with turquoise in the clasp, and a little gold heart set with turquoise; but mamma says I am too young to wear it.

MISS ANGERSTEIN. Your mamma very properly thinks that children require no other ornament than the smile of good-humour, which is far more becoming to them than even your kind godmamma's present. But what will you say, when I tell you that the favourite is not a precious stone, but merely bone?

EMILY. What! Fanny's pretty locket set with bone! Oh, dear, how disappointed I am!

MISS ANGERSTEIN. Yes, my dear; and my pretty ring also. The beautiful light blue substance that is called turquoise, has usually been considered as the bones, or teeth of animals, impregnated with blue oxide of copper. They are imported into England

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from Russia, stuck with pitch upon straws; because, if mixed together, the purchaser would not easily be able to observe their colour and ascertain their value.

ELIZABETH. What can have rendered them so valuable, if they are only bone or teeth?

MISS ANGERSTEIN. The agreeable softness of the colour, which is particularly distinguishable by candlelight; this alone has rendered it so fashionable as an ornament in female dress, that the demand is, at present, considerably greater than the supply. In Persia they are very common; and amongst the Turks they are held in such estimation, that persons of rank almost constantly wear them in some part of their dress, and to adorn the handles of their stillettos. As we are now at home, we must leave the rest of the earths for another morning.

ALEXANDER. But I have so much more to ask you. Breakfast will not be ready yet: do let us sit down under your favourite tree, and chat a bit longer. Just say "yes."

MISS ANGERSTEIN. Very willingly, for the morning is so lovely, it is absolute enjoyment to remain in the open air; and as you do not appear tired of our conversations, I have no objection to continue them for another quarter of an hour; therefore begin with your questions.

ALEXANDER. I should like to know what *obsidian* is, and where it comes from.

MISS ANGERSTEIN. Obsidian is a kind of glass, generally of a blackish colour, and is said by some

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naturalists to be formed in volcanoes, from which it issues in thick streams. But though obsidian was long supposed to have a volcanic origin, yet it appears from the accounts of those who have visited Iceland, that it is not only found in the vicinity of Hecla, but every where distributed like quartz and flint; and is besides not unfrequent in countries where volcanoes were never known to exist.

ALEXANDER. Of what use is it?

MISS ANGERSTEIN. The reflectors of telescopes are sometimes formed of it; and among the ancient Mexicans and Peruvians, it was employed as mirrors, some of which, it is said, are sometimes still found in the tombs of their ancient sovereigns. Cortez, in a letter to the Emperor Charles the Fifth, relates that he saw razors that had been formed of obsidian.

ELIZABETH. How very hard it must be!

MISS ANGERSTEIN. So hard, that the natives of Easter and Ascension Islands use this substance for cutting instruments, and for pointing their lances and spears. Our old friend Pliny says the ancients not only formed obsidian into mirrors, but also into ornamental articles of different kinds. The Danish lapidaries, who obtain considerable quantities of it from Iceland, cut it into snuff-boxes, ring-stones, and ear-pendants. I must not forget to tell you that this mineral is found not only in Iceland, as I have mentioned, but also in Siberia, in the Lipari Isles, in Sicily, in Hungary, in Madagascar, in the Island of Teneriffe, in Mexico, Peru, and in some of the South Sea Islands.

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ALEXANDER. I am a little disappointed; I thought it was a much more useful and remarkable mineral. Will you tell me what *pumice* is? for I had once a piece given me by a cabinet-maker, who told me it was very useful to him. Do you not remember it, Elizabeth? You and I used to call it the holey stone, and wonder why it was so light.

ELIZABETH. Oh, yes! I shall like to hear where that is found, for old acquaintance sake.

MISS ANGERSTEIN. As you have seen pumice, I need scarcely tell you that it is an extremely light and porous substance, of a fibrous texture, from which some persons have imagined it to be *asbestos*, decomposed by fire, as it is chiefly brought from the neighbourhood of volcanoes. It is so light, that placed in water it will float; and is employed in the cleansing and smoothing the surface of wood, leather, metal, stones, glass, and other substances; also by parchment-makers, curriers, and hat-makers; it therefore forms a considerable article of commerce, and is exported from the Lipari Isles, in great quantities, to the different countries of Europe. Sailors in the Mediterranean rub their beards off with pumice-stone, instead of shaving; and in Teneriffe, from its being so porous, it is used as a filtering stone.

JEAN. Oh! I see you are going in; but before you leave your pleasant seat, do allow me to ask one more question. Does the *Labrador stone* belong to the first class, and to the genus we are speaking of?

MISS ANGERSTEIN. Yes, my dear, it does: it is a

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member of the feldspar family, and is a very beautiful stone, of smoky grey colour, intermingled with veins and shades of blue, green, and golden yellow, exhibiting a brilliant play of colours, according to the light in which it is held. This singular mineral was originally discovered by the Moravian missionaries on the island of St. Paul, near the coast of Labrador; but it has since been found in Bohemia, in various parts of Norway, and near the lake Baikal, in Siberia. Persons who have passed in boats along the rivers of Labrador, have described the extremely brilliant and beautiful appearance which the rocks of this substance frequently exhibit in shallow places, at the bottom of the water. On account of its hardness, its brilliancy, and its capability of receiving a high polish, this species of feldspar is in considerable estimation among lapidaries for different kinds of ornamental work. And now, Jean, having answered your question, allow me to enquire what made you think of the Labrador stone?

JEAN. I just recollected an extremely pretty little box my aunt has, and which she told me was made of the Labrador stone. She also promised it should be mine when I became obliging and good-tempered; but when I shall deserve it I know not.

MISS ANGERSTEIN. I hope you are in the right road to receive it, my dear; but it depends much on your own exertions, seconded by the grace of God. How that is to be obtained, you were early taught by your excellent parents; but, lest you should oc-

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casionally forget the means, I must remind you, that the command and the promise of, "Ask, and ye shall receive; seek, and ye shall find; knock, and it shall be opened unto you," is a gracious encouragement, even to children, to pray for assistance to overcome their evil dispositions, which I hope you will eagerly embrace. I am sure it will give your kind aunt much pleasure to bestow the promised reward upon you, and my gratification will be equal to your own, when I can conscientiously say, that my dear Jean is become gentle, good-tempered, and obliging.

JEAN. I am afraid that day is very far off.

MISS ANGERSTEIN. Do not despair: you have already made some progress in the good work; persevere, and the time is not so far distant as you may imagine; for as the first efforts are the most painful in overcoming bad feelings, so every succeeding step renders the difficulty less; therefore take courage, my child, and you will soon deserve not only the pretty box, but the love and esteem of all who know you. We must now take off our bonnets.

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CHAPTER VIII.

When Miss Angerstein looked into the work-drawer, the following morning, every thing was in its proper place, and none of Alexander's unmended gloves were visible. Elizabeth, mindful of her promise, had busily employed herself the preceding evening in setting them all in order; and while on their way to the cow-house, Alexander took care to tell of her good deeds.

"Do you know, Miss Angerstein, Elizabeth mended three pair for me yesterday evening, and now I am quite comfortable."

Miss Angerstein. I am very glad to hear it; because as she has plenty of time allowed her for such purposes, there can be no excuse for neglecting them.

Emily. I do not like needlework, it always tires me so. I can read for hours and still find pleasure in it; but half an hour's work is fatiguing.

Miss Angerstein. Yet it is absolutely necessary that you should work.

Emily. Why? we can always get servants to do our work for us.

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Miss Angerstein. If your fortune is such as will allow of it, I grant you may; yet no lady should be unhandy with her needle. There are many hours when the needle proves a most useful auxiliary, even to persons of the highest rank; and as an instructress cannot exactly foresee what her pupils' future lot in life may be, it is her duty to provide against the possibility of needlework being absolutely necessary as a constant employment, by early accustoming them to the use of it. I once knew a lady, born to the expectation of a splendid fortune, but reduced by her father's untimely death (before he came to the title and estate of which he was next heir) to a very scanty pittance; she could no longer procure the comforts, much less the luxuries she had been accustomed to from her childhood. In her early education, the use of her needle had been entirely neglected, and when I knew her, she bitterly regretted the circumstance, for as she could no longer afford to pay others to do her work, it necessarily followed that she ought to do it herself; yet so helpless was she, that she could not properly mend her stockings, nor make the most simple article of clothing neatly, even after her friends had cut it out for her; consequently she was always untidy, and had the greatest difficulty in providing herself with necessary clothing.

Jean. Poor thing! how melancholy such a change must be. This certainly proves how proper it is to be able to work; but were I a person of the

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highest rank, I do not think I should trouble my needle much.

Miss Angerstein. Yet, Jean, at this moment I can mention *three queens*, to whom needlework was a source of much pleasure; and two of whom solaced many weary hours of imprisonment with this feminine employment.

Jean. Do pray tell us who they were.

Miss Angerstein. Mary Queen of Scots amused her captivity by working a bed, which is now I believe at Haddon Hall, in Derbyshire. Mary, daughter of James II. and wife of William III. used to say, that she looked upon idleness as the great corrupter of human nature; and believed that if the mind had no employment given it, it would create some of the worst for itself; and she thought that work which might amuse and divert, ought to fill up those vacant hours not claimed by devotion and business. By her, and under her direction, a suit of chair-bottoms was worked, consisting of trophies in honour of her husband. Her example had such effect, that it soon became as much the fashion to work, as it had before been to be idle.

Elizabeth. I recollect hearing my cousins, who live in that neighbourhood, speak of a scripture-piece of needlework, hung in one of the bed-chambers of the Earl of Mansfield's palace at Scone, in Perthshire, which was done by Mary Queen of Scots, during her confinement in Lochleven Castle, in Kinrosshire.

Jean. Who was the third queen?

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Miss Angerstein. The beautiful Marie Antoinette, queen to Louis the Sixteenth. During her confinement in the Tower of the Temple, she constantly worked at a piece of tapestry; and when removed from thence to the Conciergerie, the young princess, her daughter, and the princess Elizabeth, knowing how much she had always been accustomed to beguile her sorrows by work, besought permission to send her some materials. They collected all the silks and worsted they could find, and also a pair of little stockings she had begun to knit for the Dauphin; but these things she was not permitted to have, under pretence that she might destroy herself with the knitting-needles. The queen's industry, however, overcame all impediments. She found in her cell a piece of old carpet, which she unravelled, and by means of two bits of wood, she contrived to knit these ravellings into garters.

Jean. She was, indeed, determined to be employed. I do not think I should ever find any comfort in needlework, or any other kind of work.

Miss Angerstein. I once thought as you now do, Jean, and did not much enjoy sitting down to work; but I had, happily, a sensible and judicious mother, who knew much better than I did what was good for me, and she always insisted upon my doing a certain portion every day; for which I am now much obliged to her, having frequently found the comfort of being able to use my needle properly.

Alexander. I always think girls look so happy,

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when a number of them are seated at work, and one of the party reading aloud.

Miss Angerstein. So the celebrated Dr. Johnson thought; for he says, "Whenever chance brings within my observation a knot of young ladies busy at their needles, I consider myself as in the school of virtue; and though I have no extraordinary skill in plain-work or embroidery, I look upon their operations with as much satisfaction as their governess, because I regard them as providing a security against the most dangerous ensnarers of the soul, by enabling them to exclude Idleness, with her attendant train of passions, fancies, fears, sorrows, and desires." But now for our nice milk!

Alexander. And then for our minerals!

The milk was soon drunk, and as all were eager to know about the remainder of the earths, they speedily began the subject when they resumed their walk.

Alexander. *Alumine* or *argil* is to be the next genus spoken of.

Miss Angerstein. There is scarcely any mineral production more useful to mankind than alumine. In the state of clay, it forms large strata or layers of the earth, gives consistency to the soil of valleys, and of all low and damp spots, such as swamps and marshes. The beds of lakes, ponds, and springs, are almost entirely of clay. Instead of allowing of the filtration of water, as sand does, it forms an impenetrable bottom; and by this means

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water is accumulated in the caverns of the earth, producing those reservoirs whence springs issue, and spout out at the surface. Alumine is the most essential ingredient in all potteries. It enters into the composition of brick, as well as in that of the finest china: the addition of silex and water hardens it, renders it susceptible of vitrification, and makes it perfectly fit for its various purposes.

ELIZABETH. It seems so odd that bricks and China should be made out of the same substance.

MISS ANGERSTEIN. Not more singular than that coarse linen cloth and cambric should be prepared from the same material.

ELIZABETH. No, perhaps not: the transformation of the original material is very great in both instances.

MISS ANGERSTEIN. In our last conversation I explained loam to you; therefore I shall say nothing about it now, only to remind you that it belongs to this genus, and not to silex, of which we were then speaking.

FANNY. Will you not tell us something about the clay of which they make China?

MISS ANGERSTEIN. With much pleasure, if you wish it. Can you tell me the usual distinction between *earthenware* and *porcelain*? Well, as you are all silent, I suppose you do not know.

ALEXANDER. The one is thicker and more clumsy than the other.

MISS ANGERSTEIN. We say that earthenware is

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opake, and porcelain or China semi-transparent, which is owing to the commencement of vitrification.

EMILY. Why is porcelain called China?

MISS ANGERSTEIN. Because the earliest manufacture of porcelain is supposed to have been that of China and Japan. The quantity produced in China must formerly have been extremely great; as not only a considerable portion of the eastern parts of the world, but almost the whole of Europe was supplied with it. In a single province it is said that nearly a million of persons were at one time employed in this manufacture.

ALEXANDER. But a large quantity is now made in almost every country in Europe, is there not?

MISS ANGERSTEIN. The manufactory of Sevres, in France, has long been celebrated for the excellence and elegance of its porcelain. There are manufactories of beautiful porcelain at Meissen in Saxony, at Berlin, Dresden, and Austria; but none of these are at present superior to our own, in Worcestershire and Staffordshire.

ELIZABETH. It must be a superior sort of clay that is used for such delicate ware, I suppose.

MISS ANGERSTEIN. What is usually called porcelain clay, is known from the other clays by the fineness of its particles, and by its not soiling the fingers much when handled. When dry, it absorbs moisture rapidly, and it becomes very tenacious when kneaded. It occurs chiefly in countries which abound with granite and gneiss. It is found in a

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small quantity in Cornwall, and other granatic districts of England, as well as in those of Scotland and Ireland; but the most valuable kinds of this clay are found in China and Japan.

ELIZABETH. Is it used exactly as it is found, or does it undergo any previous preparation?

MISS ANGERSTEIN. It is washed several times, to free it from its impurities. After this process only about fifteen parts of pure clay remain; and this is the *kaolin* of the Chinese. To form the composition of the porcelain, this clay is mixed, in certain proportions, with quartz, flint, gypsum, steatite, or other substances, and the mixture is sifted several times through hair-seives; but as you have an explanation of the whole process in your "Book of Trades," I shall refer you to that, instead of spending our time now in describing it to you.

ELIZABETH. You mentioned that this clay was found in *granite* and *gneiss:* what are they?

MISS ANGERSTEIN. They are compound minerals that constitute rocks, which, as I before told you, were divided by geologists into primitive, transition, and flœtz. Granite as well as gneiss is a primitive rock. Granite is composed of feldspar, quartz, and mica, each in crystalline grains of various size, and promiscuously arranged: sometimes one, sometimes the other of these ingredients predominates, but generally the feldspar. It is one of the most common and most widely-extended rocks that are known. In Cornwall it is very

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abundant, and veins both of copper and tin are found in it. Scotland is remarkable for many kinds of granite.

JEAN. Is it of any use?

MISS ANGERSTEIN. The uses of this stone are numerous and important. The streets of London are chiefly paved with it, its hardness and durability rendering it peculiarly eligible for this purpose. Weather has little effect upon it, which was the reason Mr. Smeathman chose it for the outer walls of the Eddystone Lighthouse; and for this circumstance, the proprietors of Waterloo Bridge employed it in the construction of that edifice.

ELIZABETH. And gneiss?

MISS ANGERSTEIN. It is also a primitive rock, consisting, like granite, of feldspar, quartz, and mica; but differing from that rock in its structure, being slaty. Ben Lomond, and others in Scotland, and mount Rosa in Italy, are almost wholly of gneiss, as well as the middle part of the Pyrenees. It is not an uncommon rock, but in Britain is of less frequent occurrence than granite.

ALEXANDER. Feldspar and quartz we have heard of being of the siliceous genus; but with *mica,* the other material in granite and gneiss, I am totally unacquainted.

MISS ANGERSTEIN. Not so much so as you imagine, for you have been accustomed to see it from your infancy.

ALEXANDER. I was going to exclaim, " Impos-

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sible!" but happily checked myself before it passed my lips. Still I must be allowed to express my surprise, for till this moment I never heard its name.

Miss Angerstein. That I think very probable; yet if you look at that stone to which I am now pointing with my parasol, you will see several small spots of mica.

Alexander. I see nothing but the glittering sheep-silver: surely you cannot mean that?

Miss Angerstein. Indeed I do. What you, and all other Highland children call *sheep-silver*, is nothing else than mica, which is one of the most abundant mineral substances that is known. It not only occurs in a massive and crystallized state, but enters into the composition of many rocks.

Alexander. Is it always like these spots on the stones, of a silvery white colour?

Miss Angerstein. No: sometimes it is greenish, sometimes nearly black, reddish, brown, yellow, and sometimes as you here see it, of a silvery white, with a metallic lustre. Its texture is foliated, so that it is capable of being divided into extremely thin leaves, which are elastic and transparent.

Elizabeth. This bit which I have scraped off the stone is too thin to be again divided.

Miss Angerstein. Yes, my love; but in some countries, as in Siberia, it is an article of commerce, and is obtained from mines like other minerals. After it is extracted by hammers and chisels, it is

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washed, split into thin leaves or pieces, and assorted into different kinds, according to their goodness, purity, and size. I have read that plates of mica a yard or more in width, have been obtained from some of the mines in Russia.

ELIZABETH. If equally transparent with this little bit, it would be almost as useful as glass.

MISS ANGERSTEIN. One of the names by which mica is commonly known, is *Muscovy glass;* and in many parts of Siberia and Russia, thin plates of it are adopted to supply the place of glass for windows. In the shipping of Russia it is considered preferable to glass, as the concussion produced by the firing of the guns does not shatter it. It is employed instead of window-glass in Peru and New Spain, also in Pennsylvania.

JEAN. A thought has just struck me—and yet I am almost afraid of telling you what I think, lest I should not be right, and then Alexander will laugh at me.

MISS ANGERSTEIN. If there is nothing to be ashamed of in the thought, do not hesitate to tell me what it is, for fear of your brother's laughter. At the same time I would rather see you diffident, than too bold in giving utterance to every thing that crosses your mind. From me there ought to be no concealment, not even in thought; therefore take your choice, either to tell it aloud, or privately to me.

JEAN. Oh! indeed there is nothing to be ashamed

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of, so I will tell it aloud. One day, when I was at Ballock Gowan, my aunt was showing me various things in her microscope. I wanted to see the wing of a butterfly that I had found in my walk; and while she was placing it in an empty case, she gave me what I thought a piece of glass to hold, which I let slip through my fingers. It was very, very thin, and I expected to see it in a thousand pieces on the floor; but strange to say, when I picked it up, it was not even cracked. I have often thought of it, and since you have been speaking of mica, I fancied that it might have been mica instead of glass. Now do not laugh at me, Alexander.

Miss Angerstein. It would be very silly in him, if he did; for your idea is no doubt perfectly correct, as mica is constantly used for enclosing objects that are intended to be viewed by microscopes.

Jean. I am very glad I know this, for you would scarcely believe how much I have been puzzled why that thin glass did not break.

Miss Angerstein. Mica is so plentiful in Bengal, that for the value of five shillings, as much of it may be purchased as will yield a dozen panes, each measuring about twelve inches in length and nine in breadth, and so clear as to allow of ordinary objects being seen through them at the distance of twenty or thirty yards.

Alexander. It is a cheap substitute for glass. I wonder it is not used in Britain for the windows of cottages and manufactories.

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MISS ANGERSTEIN. It has its inconveniences. For instance, it soon becomes dirty, and its transparency is destroyed by long exposure to the air.

ELIZABETH. Can you tell us nothing more about our old acquaintance, sheep-silver?

MISS ANGERSTEIN. I hope for the future you will give it its proper name. I do not recollect much more. When powdered it is sold by the stationers on the continent in place of sand, for absorbing ink in writing, but it does not dry sufficiently quick to be of much use in this respect. In Russia it is employed in different kinds of inlaid work. It is also sometimes powdered, and intermixed with the glaze in particular kinds of earthenware. The heat which melts the glaze has no effect on the mica, which appears dispersed throughout the glaze, like plates or scales of silver and gold.

JEAN. How very pretty it must look! I should like to have a pretty little jug of such earthenware. Will you be so good as to give us the list of some of the minerals contained in this genus?

MISS ANGERSTEIN. Yes, my love. I had forgotten it, though I was at the trouble of writing it out for you last night after you were gone to bed. Here it is.

ARGILLACEOUS GENUS.

Native Alumine	Potter's Clay	Tripoli
Porcelain Clay	Pipe Clay	Float Stone
Common Clay	Variegated Clay	Alum Stone
Loam	Polishing Slate	Aluminous Schistus

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Bituminous Schistus	Schistose Hornblende	Green Earth
Drawing Slate	Basalt	Lithomarga
Hone, or Whet Slate	Wacken	Indurated Lithomarga
Mica	Phonolite, or Clinkstone	Rock Soap
Potstone	Lava	Umber
Chlorite		Yellow Earth
Hornblende		

ALEXANDER. I should like to know something about *Tripoli;* for I can form no idea what it is, nor what may be its uses.

JEAN. I can tell you of one of its uses, for I have seen Kate use it to polish the fire-irons and fender in the nursery.

MISS ANGERSTEIN. I dare say you have, as it is much liked for such purposes.

ALEXANDER. As I have never seen it, perhaps you will be so kind as to tell me what it is like, and why it is called Tripoli.

MISS ANGERSTEIN. It is a kind of clay of yellowish grey, or brown colour, and of an earthy texture. It obtained its name from having formerly been imported into Europe from Tripoli, on the north coast of Africa. It is, however, now found in several parts of Germany; and a granulated kind has been discovered in England. When Tripoli is used for the polishing of metals and stones, it is mixed with sulphur: when combined with red ironstone it is valuable for polishing optical glasses. Near Burgos, in Spain, a kind of Tripoli is found, which is used as an ingredient in the manufacture of porcelain. You

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have all heard of *rotten stone*, I believe. This is a kind of Tripoli, dug in Derbyshire and several parts of Staffordshire, and serves most of the same purposes as Tripoli.

ELIZABETH. *Pipe-clay*, I suppose, is used for nothing but the making tobacco-pipes.

MISS ANGERSTEIN. It forms the basis of that yellow ware which is called the *queen's ware;* and is also formed into oblong pieces, dried, and employed for cleaning white woollen cloth, and for various purposes of domestic utility.

JEAN. *Alum-stone* I should be glad to know something about, as I suppose what we call alum is prepared from it.

MISS ANGERSTEIN. The salt called Roman alum, so celebrated in commerce, is procured from the alum-stone, which is also called the stone of Tolfa, from the name of the place where the stone is found, near Civita Vecchia, in the Roman territories; but the alum in general use is procured from the common aluminous schistus, or alum-slate, which is very abundant in Saxony, Bohemia, France, England, and some parts of Scotland.

ELIZABETH. Why is Roman alum so celebrated?

MISS ANGERSTEIN. For its excellence; which may be owing to the mineral containing within itself all the ingredients necessary to the formation of that salt. There is another kind, called Levant or Roche

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alum, which is said to have derived its name from Rocca, the present Edessa, in Syria.

ALEXANDER. In my passage from London here, we passed very near Whitby, and a gentleman on board told me that it was celebrated for its alum-works. Is the alum-slate found there?

MISS ANGERSTEIN. Yes: the rock of alum-state near Whitby, is supposed to be nearly twelve miles in extent, and affords a most abundant supply of alum. This manufacture was first established about the conclusion of the sixteenth century, by Sir Thomas Chaloner, who was tutor to James the First's son, Henry, Prince of Wales; and is supposed to have obtained his knowledge of the process from the alum-works which had then lately been introduced into Germany and Spain.

ALEXANDER. Then alum is never found quite pure?

MISS ANGERSTEIN. The stone of Tolfa affords the purest; and at Solfaterra, near Naples, and in other volcanic countries, an abundance of alum is found in a state of efflorence, from the lava.

JEAN. What do you mean by a state of *efflorescence?*

MISS ANGERSTEIN. *Efflorescence* means the powder formed on some saline substances by exposure to the air: when the moisture is absorbed by the atmosphere they lose their transparency, and have a mealy appearance.

ELIZABETH. In the list is *drawing-slate:* is there

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any thing remarkable in it, or is it merely the common slate we write upon?

Miss Angerstein. Black chalk, or drawing-slate, is a most useful article to crayon-painters and other artists. You use a good deal of it, my dear, for your drawing, but were unconscious of its nature.

Elizabeth. What! is the black chalk I draw with, of the same nature as the slate on which I do my sums?

Miss Angerstein. Yes, my dear; it belongs to the same genus, and is not only used as a crayon, but is also pounded or ground into a black powder, and mixed with oil, for painting. Considerable quantities of it are imported from France, Spain, and Italy. That from Italy is the best, being more free from gritty particles, more firm and compact in its texture, and in its touch much smoother than that brought from any other country. To preserve your chalk crayons in the greatest perfection, you should keep them in a moist place.

Jean. Then what are our *slate-pencils?*

Miss Angerstein. They are made of a particular kind of slate, which on splitting, falls into long splintery fragments. Such is the shivery nature of the slate of which they are made, that if it be exposed for some time to the action of the sun or frost, it is rendered useless; for which reason the workmen are careful to cover it up and sprinkle it with water, as soon as it is taken from the quarry, and to preserve it in damp cellars. The pieces are after-

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wards split by a particular instrument, and then wrought into the requisite shape.

FANNY. The slate I write on, where does that come from?

MISS ANGERSTEIN. Most likely from Wales, as there are vast quarries near Bangor, in North Wales. I suppose you know that slate, like mica, is of a foliated texture, or divides into thin leaves. Writing slate, or table-slate, as it is called, after it is split of a proper thickness, is smoothed with an iron instrument; it is then ground with sandstone, and slightly polished with Tripoli: lastly, it is well rubbed with charcoal-powder, cut into the required shape, set in a wooden frame, and is then ready for use.

ELIZABETH. Have we no slate-quarries in our dear Scotland?

MISS ANGERSTEIN. The slate-quarries in Ensdale in Roxburgshire, are so extensive as to furnish annually more than five millions in number, and to give employment to upwards of three hundred men. I dare say there are others, but those are the only extensive ones I have heard of.

JEAN. I do not think slate can be a very useful mineral: I know of few uses to which it is applied.

MISS ANGERSTEIN. Its principal use is in roofing houses. There are extensive quarries near Kendal in Westmoreland; and the Kendal slates, which are of a bluish green colour, are more highly esteemed than those from Wales; for though they are not

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of a large size, they possess great durability. In some of the quarries in Derbyshire and Wales, the slate is so thick as to admit of being split into large and tabular pieces, which are used for grave-stones, and slabs for dairies and cellars. Paving-stones and mile-stones are also formed of them, as well as vessels for the salting of meat and setting the milk in dairies. Cut into narrow strips, slate has also been applied in the neighbourhood of Bangor for the formation of fences. When sufficiently solid, slate is cut into inkstands, and turned into various fancy articles. I have a pair of very pretty vases turned in slate.

JEAN. Will you show them to us?

MISS ANGERSTEIN. I cannot, my love; for they are in England with many, many other things. Pounded slate is advantageously used for cleaning iron and other metals. When well ground and mixed with a certain proportion of loam, it is made into moulds for the casting of metals; and when burned and coarsely ground, slate is used instead of sand, in the making of a solid and impermeable mortar or cement, for the parts of buildings which are under water.

JEAN. I seemed to have been greatly mistaken about slate, for you have enumerated many useful purposes to which it is applied.

ALEXANDER. What is *basalt*? I have heard much talk about the basaltic columns of the Giant's Causeway in Ireland.

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MISS ANGERSTEIN. Basalt is a greyish-black and coarse-grained stone, which is usually found in globular, distinct pieces, or in groups of large columns, each of which has from three to eight sides, and is divided horizontally into numerous stones, that very exactly lie upon, or fit into each other. It is not uncommon in any part of the globe, and is very abundant in many places. It is found in regular columns in several of the Hebrides on the west coast of Scotland, as in Cannay Eigg, but particularly beautiful in Staffa. Pretty regular columns are observed also at Dunbar, and on the south-west side of Arthur's Seat near Edinburgh; but the Giant's Causeway, and the rocks about Fairhead on the north coast of Ireland, exhibit the finest and most extensive ranges of columnar basalt in the world.

JEAN. But of what use is it?

MISS ANGERSTEIN. Amongst the uses to which basalt is applied, two of the most important are, as materials of an excellent and durable kind for building and paving. When burned and pulverized, these stones, like slate, impart to mortar (with which they are mixed) the property of hardening under water. They easily melt, without any addition, into an opaque and black glass; and from them bottles have been formed of extreme lightness, but of great strength and solidity. It is occasionally used by artists for *touch* or *test* stones, to ascertain the purity of gold or silver. Some of the kinds have been ad-

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vantageously employed as millstones; and gold-beaters and bookbinders, on the continent, usually make their anvils, or beating-blocks of it. Though harder, more brittle, and less pleasing in its colours than marble, basalt was in considerable esteem among the sculptors of antiquity, on account of its great durability. Many fine works were consequently executed in this stone. Pliny, who has described several, states that the columns of it were sometimes so large as to admit of several figures being wrought out of them. The Emperor Vespasian had an entire statue, accompanied by the figures of sixteen children, cut out of a single column of basalt. This statue he placed in the Temple of Peace, and dedicated it to the Nile. The famous statue of Minerva, at Thebes, is described by travellers to have been formed of basalt. Antiques of basalt are always in a much higher state of preservation than those of marble: even such as are dug out of the earth still retain their original polish, and the finest touches of the chisel upon them are still unimpaired.

ALEXANDER. I hope now, Jean, you are satisfied as to its usefulness, and that you will allow me to enquire after its beauties. Fingal's Cave in the Island of Staffa is formed of basaltic columns, is it not?

MISS ANGERSTEIN. According to the account given of it by the late Sir Joseph Banks, nearly the whole of the Island of Staffa is supported by basaltic pillars; but the superb Cave of Fingal presents the

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finest collection of columns. It is supported on each side by ranges of columns, and is roofed by the bottoms of such as have been broken away. From the interstices of the roof a yellow stalactitic matter exudes, which, by varying the colour, tends to augment the elegance of its appearance. What adds to the grandeur of the scene, the whole cave is lighted from without in such a manner that the furthest extremity is plainly distinguished; while the air within, being constantly in motion, owing to the flux and reflux of the tides, is perfectly dry and wholesome, and entirely exempt from the damp vapours to which natural caverns are generally subject. I do not recollect the dimensions of the cave, but will give them to you, if you wish it.

ALEXANDER. I must ask you to describe the Giant's Causeway to us; and then, if my sisters have no further questions to ask, we will pass on to the next genus.

MISS ANGERSTEIN. I could not venture to give you a description of that natural curiosity from memory; and as I conjectured I should have some enquiries made concerning it, I have copied the account of it, as given by Dr. Pococke, bishop of Ossory, a celebrated traveller and antiquary, which you may read aloud to your sisters.

(Alexander reads.)

"The Giant's Causeway is composed of pillars, all of angular shapes, from three sides to eight. The eastern point, where it joins the rock, termi-

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nates in a perpendicular cliff, formed by the upright sides of the pillars, some of which are thirty-three feet four inches high. Each pillar consists of several joints of stones, lying one upon another, from six inches to one foot in thickness; and what is very surprising, some of these joints are so convex, that their prominences are nearly quarters of spheres; round each of which is a ledge, which holds them together with the greatest firmness, every stone being concave on the one side, and fitting in the exactest manner the convexity of the upper part of that beneath it. The pillars are from one to two feet in diameter, and generally consist of about forty joints, most of which separate very easily, and one may walk along upon the tops of the pillars as far as the edge of the water.

"But this is not the most singular part of this extraordinary curiosity, the cliffs themselves being still more surprising. From the bottom, which is of black stone, to the height of about sixty feet, they are divided at equal distances, by stripes of a reddish stone that resembles a cement, about four inches in thickness: upon this there is another stratum of the black stone, with a stratum five inches thick of the red. Over this is another stratum ten feet thick, divided in the same manner; then a stratum of the red stone twenty feet deep, and above that a stratum of upright pillars; above these pillars lies another stratum of black stone twenty feet high; and above this again, another stratum of up-

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right pillars, rising in some places to the tops of the cliffs, in others not so high, and in others again above it, where they are called the chimneys. The face of these cliffs extends about three English miles."

ELIZABETH. Are there any basaltic columns on the continent, or have they been discovered in the British Isles alone?

MISS ANGERSTEIN. In the country surrounding Padua, in the State of Venice, there are several basaltic columns similar to those of the Giant's Causeway, although less magnificent in appearance. About seven miles, in a southern direction, from that city, is a hill named Monte Roso, or the Red Mount, which presents a natural range of prismatic columns, of different shapes and sizes, placed in a direction nearly perpendicular to the horizon, and parallel to each other. Remarkable basaltic columns occur also at Catania, and in other parts of Sicily, and in Auvergne in France.

ALEXANDER. *Green earth*, *umber*, and *yellow earth*, are, I conclude, employed in painting.

MISS ANGERSTEIN. Yes: green earth is found at Verona, in Italy; umber in the Island of Cyprus; and yellow earth at Wehraw, in Upper Lusatia. I think we may now take our leave of this genus, and proceed to the next.

JEAN. Before we do so, I should like to know what sort of stone *lithomarga* can be.

MISS ANGERSTEIN. Lithomarga, or stone mar-

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row, derives its name from its being found in nodules in amygdaloid rocks. It is found in Bohemia, Saxony, France, England, and at the Giant's Causeway in Ireland. A variety of lithomarga, which exhibits many fine colours, particularly violet, or lavender blue, is found at Planitz, near Zwickau in Saxony, which, from its beautiful appearance, has been called *wonder earth* (terre miraculosa) of Saxony.

ELIZABETH. What is meant by an *amygdaloid rock?*

MISS ANGERSTEIN. A rock consisting of a compact ground, with cavities which have been filled up with some other mineral substance. It derives its name from *amygdala*, the Latin for almond, on account of its kernel-shaped cavities. What is the next genus, Alexander?

ALEXANDER. *Zircon.*

MISS ANGERSTEIN. This will not occupy us very long, as I have very little to say about it. Zircon, when pure, is rough to the touch, insipid, and insoluable in water. It is found combined with other substances only in a few rare minerals, as in the hyacinth and jargoon. Hitherto the zircon has not been put to any useful purpose. It is about four times heavier than water, and has been proved to be composed of oxygen united with a base, *zirconium*, the nature of which is not known. Here is the table or list.

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ZIRCON.

Jargoon. Hyacinth.

ALEXANDER. From such a tremendously *long* list, what shall we first ask to have explained?

MISS ANGERSTEIN. I will solve your difficulty by beginning with the *jargoon*, which is a gem usually of smoky yellow, or brownish colour. If placed upon any object, it has the singular property of exhibiting a very distinct double image of it. The greyish white and yellowish white varieties of jargoon are valuable chiefly on account of their resemblance to the diamond. The darker coloured varieties can be deprived of their colour by heat; and in this state, though in lustre they are infinitely inferior to them, they are sometimes substituted for diamonds. Jargoons are now seldom used except for the jewelling of watches and time-pieces. About a century ago they were much used in mourning ornaments, for which the dark tone of their colour was supposed to be peculiarly appropriate.

ELIZABETH. Where does it come from?

MISS ANGERSTEIN. Principally from the Island of Ceylon; but it has lately been found in Norway, and is occasionally found in France and Spain; and in the granite rocks near Cuffel, in Dumfriesshire, your own dear Scotland.

JEAN. Now we have no choice left, for there is but one more species in the list.

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ALEXANDER. Yet we still have a choice, Jean.

JEAN. Oh, yes, sir! I understand you. You mean, we may either ask to have a description of it, or leave it alone; but I vote for the description.

MISS ANGERSTEIN. Which is very much at your service, my little girl. The *hyacinth* or *jacinth*, is a dark orange-red variety of the jargoon. It is found in Ceylon, in Brazil, in Bohemia, and in the rivulet Expailly, in Velay in France; and also in the neighbourhood of Pisa, in Italy. Its chief importation is, however, from Ceylon, where it is found in the sand of rivers, in irregularly round pieces, but seldom of large size without flaws. When bright, and free from all imperfections, the hyacinth is a superb ring-stone; but it is not often see in modern jewellery.

ELIZABETH. I am much surprised at its colour being red: from the name of hyacinth, I fancied it was something of a violet.

MISS ANGERSTEIN. There are, however, red hyacinths, as well as blue, white, straw-colour, and pink; and this stone is indebted for its name to a supposed resemblance in colour to the red species of that flower, which according to the Heathen Mythology, Apollo raised from the blood of a favourite youth, Hyacinthus.

ALEXANDER. Are there no varieties beyond the two just mentioned?

MISS ANGERSTEIN. The *cinnamon-stone* is by some said to be a variety of the hyacinth; and by others it is considered as a distinct species, a kind of

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garnet; but the differences are so very slight, either in colour or character, that the same description serves for both.

ALEXANDER. *Glucine* then is the next genus.

MISS ANGERSTEIN. Glucine obtains its name from a Greek word signifying *sweet*, on account of the sweet taste by which its salts are distinguished. When pure, glucine is a white powder, soft and somewhat unctuous to the touch, and is nearly three times the weight of water. This earth was discovered by Vanguelin in 1789, and has hitherto only been found in small proportions in the beryl, the emerald, and the gadolinite; but neither the pure earth, nor any of its salts have as yet been applied to any use.

ALEXANDER. I thought the emerald and the beryl belonged to the silicious genus of stones.

MISS ANGERSTEIN. So they are always classed; yet I believe I explained to you that other substances entered into their composition, and that none of them were pure silex. Glucine, silex, alumine, and lime, compose the beryl; and the emerald consists of glucine, silex, alumine, lime, and the metal called chrome.

ELIZABETH. Then, as so little can be said of this earth, will you tell us something about the emerald?

MISS ANGERSTEIN. By the ancients the emerald was a gem much in request, particularly for engraving upon. They denominated it *smaragdus*, and are said to have procured it from Ethiopia and Egypt. The most ancient emerald-mine with which we are

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acquainted, is that of Manta, in Peru, but it has been some time exhausted; and most of the emeralds that are now brought to Europe, are obtained from a mine situated in the Valley of Tunca, between the mountains of New Granada and Popayan. The largest emerald that has been mentioned, is one said to have been possessed by the inhabitants of the Valley of Manta, in Peru, at the time when the Spaniards first arrived there. It is reported to have been as big as an ostrich's egg, and to have been worshipped by the Peruvians under the name of the *Goddess*, or Mother of Emeralds. They brought smaller ones as offerings to it, which the priests distinguished by the appellation of daughters.

ELIZABETH. I know the emerald is a beautiful green; but what colour is the beryl?

MISS ANGERSTEIN. The *beryl*, or *aqua-marine*, is a light, or mountain-green variety of the emerald, sometimes straw-coloured, bluish, yellow, or even white. The most beautiful kinds are brought from Dauria, on the frontiers of China, from Siberia, and Brazil. They are also found in Saxony and the south of France, and are very common at Baltimore, in North America. Specimens of aqua-marine have been obtained from the upper parts of Aberdeenshire; also embedded in granite, near Lough Bray, and Cronebane, in the county of Wicklow in Ireland, and also in mountain-rock in Devonshire.

JEAN. The next genus is *yttria*.

MISS ANGERSTEIN. It is so, and will not occupy

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very much of our time. It is an extremely rare earth, and though it bears a considerable affinity to glucine, yet it is easily distinguished from it, even by its weight, which is five times heavier than water. It was discovered by the Swedish professor, Gadolin, who named the earth yttria, because the black mineral in which it was discovered was brought from Ytterby, in Sweden.

ELIZABETH. What mineral was it found in?

MISS ANGERSTEIN. In a black Swedish mineral, which received the name of *gadolinite*, professor Gadolin having been the first to analyze it; and in *yttrocolumbite*, another scarce mineral, also from Sweden.

ALEXANDER. At this rate we shall get through the earths this morning; for as so little is known of yttria, we must now travel forwards to barytes.

MISS ANGERSTEIN. *Barytes* has never been found pure in its natural state, but always combined either with the sulphuric acid, forming sulphate of barytes, (which was formerly distinguished by the name of heavy spar, phosphoric spar, or Bolognian stone,) or with the carbonic acid, forming carbonate of barytes, known by the names of *aerated heavy spar*, *aerated baroselenite*, and *witherite*, from the name of Dr. Withering, who first discovered it to be a natural production. It received the name of barytes, from a Greek word signifying heavy; and was decomposed by the late Sir Humphrey Davy, who discovered it to have a metallic base, which he called barium.

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JEAN. There is more to be said about this earth than the two last, for I should like to know what *phosphoric spar*, or Bolognian stone may be. Will you be so good, ma'am, as to tell us something respecting it?

MISS ANGERSTEIN. It is a very remarkable kind of barytes, which has its name from being found near Bologna, in Italy. When detached, this substance is usually observed in roundish, flat, kidney-shaped pieces, from about the size of a walnut to that of an orange, which have a shining and somewhat fibrous texture within. When the outer coat of this stone is washed away by heavy rains, it has sometimes the appearance of burnished silver. An Italian shoemaker, in the year 1630, deceived by this appearance, carried home several pieces, hoping, by means of fire, to extract silver from them. Disappointed in this expectation, he was, however, greatly surprised by an unlooked for phenomenon. All the pieces which he had thus attempted to melt, when they were afterwards exposed to the light, became themselves luminous.

JEAN. How very singular! Do you really mean that they gave light like a candle?

MISS ANGERSTEIN. It more resembles a glowing coal than a candle. It is the singular property of the Bologna phosphorus, after it has undergone calcination in a particular manner, to become capable of imbibing so much light, on exposure for a little while to the light of the sun, or even to the flame of a

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candle, that it will afterwards shine in the dark for an interval of from eight to fifteen minutes, but without any sensible heat. The light which it emits is sufficient to read by, provided the letters be placed near it. If well prepared, the stone will retain this extraordinary property for five or six years.

ELIZABETH. Barytes has proved an amusing earth, for I never heard of any thing more extraordinary than the Bolognian stone. I hope *strontian*, which is the next on the list, may be equally so.

MISS ANGERSTEIN. It so strongly resembles barytes in its properties, and is so sparingly found in nature, and of so little use in the arts, that it will not be necessary to enter into any particulars concerning it.

JEAN. Will you not then tell us where it is found?

MISS ANGERSTEIN. It was originally found at Strontian, in Argyleshire, by Dr. Crawford; but it occurs in various parts of the world. One of the most remarkable characteristic properties of strontian, or strontites, as it is sometimes called, is, that its salts, when dissolved in spirits of wine, tinge flame of a deep red, or blood colour.

ALEXANDER. I am so glad we are now coming to one that is better known; for I do not like to have so many earths dismissed in so summary a manner. *Lime*, I believe, is the next to come under consideration.

MISS ANGERSTEIN. It is: and the great abun-

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dance in which it is found in nature, and the important uses to which it may be applied, led men to employ it for many purposes, from the earliest ages of the world. It was well known to the ancients as mortar, and as a manure, and they were not unacquainted with some of its medicinal virtues; but it was long before the nature and properties of lime were fully known, and particularly those changes which quick-lime undergoes when it is exposed to the air, or lime-stone to the action of heat.

ELIZABETH. Is lime found in a pure, unadulterated state, or must it undergo some cleansing process, before it can be obtained?

MISS ANGERSTEIN. Lime has never yet been found in a pure state; but when so prepared by the chemist, is moderately hard, and of a hot, acrid taste. Its affinity for water and carbonic acid is so great, that it is always found combined with these substances, with which it forms the common limestone; but it is separated in the kiln from these ingredients, which are volatilized whenever a sufficient degree of heat is applied.

ALEXANDER. When lime has been burnt in a kiln, I have heard it called quick-lime; and very caustic stuff it is, for I have more than once burnt my fingers and clothes with it. In this state is it pure lime?

MISS ANGERSTEIN. Yes: pure lime is nothing but limestone, deprived, by heat, of its water and carbonic acid. It has been proved, by Sir Humphrey

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Davy, to consist of oxygen united with a base considerably resembling some of the metals. This base he calls *calcium:* it has the colour and lustre of silver; but the chemist has not yet been able to examine it, for on exposure to air and heat it instantly takes fire, and burns with an intense white light, and by the absorption of oyygen is reconverted into lime.

ELIZABETH. How very vexatious! So there is no hope of any further experiment being made upon calcium, as I think you call it?

MISS ANGERSTEIN. At present there is no prospect of it; but as science improves, some further discoveries may be yet expected, even in this unmanageable substance.

JEAN. Now, dear Miss Angerstein, where is the list, that we may begin our questions? I hope it will be a very, very long one.

CALCAREOUS, OR LIMESTONE GENUS.

Agaric Mineral	Pisolite, or Pea Stone	Swinestone
Chalk	Calcareous Tufa	Marl
Limestone	Foam Earth	Fluor Spar
Oolite, or Roe Stone	Calcareous Alabaster	Gypsum
Calcareous Spar	Lias, or Calpe	Fibrous Gypsum
Marble	Dolomite	Florence Marble

MISS ANGERSTEIN, *(giving them the above list.)* I could not meet with any thing particularly interesting for you, but will answer your questions to the best of my ability.

EMILY. Before they begin, I want you to tell

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me what you meant by *calcination*, when you were speaking of the Bologna phosphorus, for I do not understand that word.

Miss Angerstein. You are a good little girl for asking, and I have great pleasure in answering such questions. *Calcination* means, reducing a substance to powder by means of fire.

Elizabeth. I also wanted to ask what was meant by lime having an *affinity* for water and carbonic acid.

Miss Angerstein. *Affinity* is a chemical term, to express the tendency which bodies of different kinds have of combining together, and by which compounds are produced, having very different qualities from their constituent parts.

Jean. What are the most useful purposes to which lime is applied?

Miss Angerstein. The principal use is in the formation of mortar, or cement for buildings. Various examples might be mentioned of buildings nearly two thousand years old, where the mortar is, at this day, as hard as the stones which it cements together. Lime is also used for agricultural purposes: when spread upon land, it is supposed to hasten the dissolution and putrefaction of all kinds of animal and vegetable substances, and to impart to it a power of retaining the moisture that is necessary for the vigorous growth of corn or grass. It is employed in the refining of sugar; in the manufacture of soap; in the melting of iron; and by tanners, in

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a state of solution, for dissolving the gelatinous parts of the skin, and removing the hair from it. If swallowed, or inhaled, lime is a virulent poison; yet notwithstanding this pernicious quality, it is of considerable use in medicine.

JEAN. What an extremely useful mineral it is! Without lime, our houses would not be so firm and warm as they now are.

MISS ANGERSTEIN. It is most invaluable to us. Some years ago the superb basin of Lampi, one of the principal reservoirs which furnishes the canal of Languedoc with water, was found to leak at the junction of the stones. The engineer who had the direction of the works, caused lime to be slacked in the water. This passing through the apertures between the stones, formed a crust, or very white covering, over its whole surface, of so hard and durable a nature, that it now constitutes one solid and undivided substance, which the water cannot penetrate.

ALEXANDER. Of what an unspeakable advantage is really sound knowledge! By this engineer's acquaintance with the chemical properties of lime, he effectually put a stop to the leaking of the reservoir, and conferred a lasting benefit on mankind.

MISS ANGERSTEIN. Never forget what you have just said, my dear boy; and when you return to Eton, and feel idly inclined, remember, that without application, knowledge cannot be attained; and let the recollection incite you to increased diligence, that

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you may realize the hopes which your fond father has formed of you.

ALEXANDER. I fully intend to be extremely diligent; and I hope I shall, at any rate, partly succeed in my intentions. I have been so much interested hitherto in your sketch of mineralogy, that I mean to pursue the study of it by reading such books as I can obtain upon the subject, and all my spare money must be laid aside to procure specimens of such as come within reach of my purse. But the walk is half over, and we have much yet to learn, therefore I shall now begin my questions, by asking if you have any thing to tell us about *chalk*.

MISS ANGERSTEIN. No very great deal: it is too well known to need much description, therefore I shall merely mention that it is a white or yellowish kind of limestone, which is found abundantly in many of the southern counties of England, and is usually procured from large chalk-pits, by digging. In some parts of Kent, however, the workmen save themselves, in this respect, much trouble. They undermine the sides of hills to a certain depth, then dig a trench at the top, as far distant from the edge as the mining extends at the bottom. This trench they fill with water, which soaks through during the night, and the whole mass is thereby loosened, and falls down before morning.

ELIZABETH. Then Englishmen can save themselves the trouble of digging chalk, as well as Frenchmen in the splitting of millstones. But chalk is surely found in other countries than England.

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Miss Angerstein. In many other places: a great body of chalk traverses France from south to north, extending from Champagne to Calais, and from thence to the south of England; it is also found in the Island of Zealand, in the Baltic, in Poland, &c. &c. forming, in many places, mountains, containing many petrifactions, also flints, arranged in regular strata; but no metallic substances are ever found in chalk.

Alexander. Jean being always so very anxious about the useful qualities of every mineral, I mean to be beforehand with her this time, and to enquire whether chalk is of any particular use?

Miss Angerstein. The harder and more compact kinds of chalk are cut into blocks, and used as building stones. When burned and formed into lime, chalk becomes an excellent mortar: nearly all the houses in London are cemented with chalk-mortar. It is also used as lime in agriculture. With isinglass, or the white of egg, it forms a valuable cement. By artists it is in request to make moulds to cast metals in; and by carpenters and others, as a material to mark with. When pounded and cleared from gritty particles, it has the name of whiting, which is used for the cleaning and polishing of metallic and glass utensils, for whitewashing the ceilings of rooms, and numerous other purposes. Spanish white is the same substance cleansed with peculiar care; and the Vienna white, used by artists, is perfectly purified chalk.

Alexander. I think even Jean must be satisfied

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with the usefulness of this mineral. Are you not Jean?

JEAN. Perfectly so, sir; and to stop your quizzing, I shall enquire what *oolite* or *roe-stone* may be, which will give either you or me another opportunity of becoming acquainted with some more useful properties.

MISS ANGERSTEIN. I am pleased, my dear Jean, to see you bear your brother's playful remarks so good-humouredly; it is the only way to put a complete stop to quizzers of all kinds, for they soon leave off when they find their jokes are disregarded, or taken in good part; and as I do not think Alexander's intention was to tease you, you have acted very wisely in turning the subject off in his own playful manner.

ALEXANDER. No, indeed; teasing was very far from my thoughts; but I can never help smiling at Jean's constant enquiries upon the *usefulness* of each mineral.

MISS ANGERSTEIN. I greatly approve of such questions, and hope she will have too much good sense to be laughed out of her enquiries, which I shall always answer with pleasure. So, my dear Jean, we will now return to the oolite, or roe-stone, which is so called because its grain has a singular resemblance to the petrified roe of a fish. It is found in Sweden, Switzerland, Saxony, and the south of England. Portland stone, from Portland Island, near Weymouth, in Dorsetshire; Bath stone, from

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Bath; and Ketton stone, from Ketton, in Rutlandshire, belong to this variety. Several of the colleges in Cambridge are built of Ketton stone. The bridges, St. Paul's cathedral, the Monument, and nearly all the buildings of late date in London, are constructed of Portland stone, which was first used there in the reign of James the First; that monarch, by the advice of his architects, having employed it in the construction of the banquetting house at Whitehall; and after the great fire in London, it was brought into general use by Sir Christopher Wren.

FANNY. I know the great fire of London happened in 1666, a year after the great plague, in the reign of Charles the Second; but I do not know who Sir Christopher Wren was.

MISS ANGERSTEIN. He was the greatest architect of that age, and a good mathematician and astronomer. St. Paul's cathedral, the Monument, the churches of St. Stephen, Walbrook; St. Magnus, London Bridge, and St. Dunstan's in the East, in London; with the theatre at Oxford, are proofs of his eminence in architecture.

ELIZABETH. Why is Portland stone so much preferred in building?

MISS ANGERSTEIN. Because this sort of stone, when first dug out of the quarry, is so soft, that it is readily worked into any form which use or ornament may require, which is owing to the moisture with which it is naturally impregnated; but when it once becomes hardened, by exposure to the sun and air, it

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is extremely firm and solid. On the contrary, other kinds of limestone that are used for building, imbibe and retain the moisture of the atmosphere, in consequence of which they burst, or are crumbled by frost.

ELIZABETH. I am very desirous of hearing something of the various *marbles*, for I always admire them so very much. Will you give us some account of them?

MISS ANGERSTEIN. Although nearly all the kinds of marble may be burned, and thus converted into quick-lime, yet their use in ornamental architecture is so important, as in general to prevent their application to the inferior purposes of mortar. Marble was known at a very early period, for the Book of Esther, in the Old Testament, describes the palace of Ahasuerus to have had "pillars of marble," and the pavement of "red, and blue, and white, and black marble."

The most valuable of the calcareous marbles, for hardness, durability, and colour, are brought from Italy, the Greek Islands, and from Syria. When the ancient Romans were at the height of their civilized luxury, they obtained some varieties of marble from Numidia in Africa, and other countries, which were much esteemed.

ELIZABETH. But you will give us some account of the different varieties, will you not? I want to know where they come from, and which are most admired.

MISS ANGERSTEIN. It would be impossible for

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me, my love, to describe, or even to enumerate all the different kinds of marble which were known to the ancients, or are known to the moderns. But here is a list of some of the most important.

Greek and Italian Marbles.—Pentelic marble, Greek white marble, Parian marble, Carrara marble, Luni marble, Verde Antique marble, Sienna marble, Brocatello marble, Mandelato marble, Verde di Prato marble, Lago Maggiore marble, Bretonic quartz.

French Marbles.—Campan marble, Griotte marble, Marquese marble, Sarencolin marble, St. Beaume, or Languedoc marble, Breccia marble of the Pyrenees.

Spanish and German Marbles.—White Spanish marble, Seville marble, Spanish Breccia, Lumachelli marble.

British Marbles.—Petworth marble, Purbeck marble, Babbicombe marble, Derbyshire marble, Kendal marble, Mona marble, Tirie marble, Assynt marble, Isle of Skye marble, Sutherland marble, Glen Tilt marble, Blairgowrie marble, Glenavon marble, Balliculish marble, Blairmachyldach marble, and Black marble.

ALEXANDER. Out of this numerous list it is difficult to say which are of least consequence, as we are unacquainted with most of them; therefore, after you have given us a few particulars of the Pentelic and Parian marbles, we must trust to your kindness for a description of such as may be most interesting.

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Miss Angerstein. I cannot spend much time over them, but I will do my best for you. *Pentelic marble*, of a beautiful white colour, was obtained from Mount Pentelicus, near Athens, and was generally preferred by the Grecian artists to Parian marble, which it greatly resembles. The Parthenon was built entirely of Pentelic marble; and many of the Athenian statues and works carried on near Athens, during the administration of Pericles, were executed in it. There are numerous examples of Pentelic marble in those works of Phidias which form the Elgin collection in the British Museum. *Parian marble*, which is obtained from the Island of Paros, one of the Cyclades, is of snow-white colour, and when polished, has something of a waxy appearance. It hardens by exposure to the air, and is one of the most permanent kinds that is known. It was named *lychnites* by the ancients, from a Greek word signifying a lamp, because it was generally hewn in quarries by the light of lamps. The finest Grecian sculpture that has been preserved to the present time, is of Parian marble; such are the Venus di Medici, Diana Venatrix, and Venus leaving the Bath. *Carrara marble*, the purest of all the kinds with which we are acquainted, is almost the only one in use by modern sculptors, and is procured from quarries near the town of Carrara in Italy. In the centre of the blocks a beautiful kind of rock crystal is sometimes found, called Carrara diamonds. It is usually supposed that the Apollo Belvidere, and the Antinous of the Capitol, were wrought out of the *Luni marble*,

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which was dug by the ancients from quarries on the coast of Tuscany.—The quarries from which the *Verde Antique* of the Italians was procured, are not now known, but they are supposed to have been in some part of Italy. Spain is very productive in marble, and in few countries are the public monuments and buildings more profusely decorated with it. The dome of the theatre of Toledo is supported by three hundred and fifty marble columns; and an ancient mosque at Cordova is ornamented with twelve hundred columns, most of which are of Spanish marble. The palace and church of the Escurial, built by Philip the Second, (in performance of one of the vows he made during the battle of St. Quentin,) and many of the churches of Madrid, are decorated with marbles of the most beautiful description.—Many beautiful kinds of marble are obtained from the Island of Sicily, particularly one called *Silician jasper*, which is red, with stripes like ribbons, white, red, and sometimes green. Switzerland abounds in marbles; Portugal, Sweden, and Norway afford few. In the Russian empire many have been noticed, particularly among the Uralian Mountains. The Empress Catherine the Second caused an immense palace to be built for her favourite Orloff, which is entirely coated, both inside and outside, with marble. On a vast space, near the statue of Peter the Great, in St. Petersburg, she built the church of Isaac, with marbles of different kinds.—With the marbles of Asia we are but very imperfectly acquainted; and no account has hitherto been published of the marbles of Africa.

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In the United States of America many kinds of marble have been discovered, some of which have been wrought and polished; but very imperfect descriptions of them have as yet been given. Of the British marbles, few, if any, are fit for the chisel of the sculptor; but a great variety of them are highly ornamented, and are wrought into chimney-pieces, small columns, slabs, vases, and other ornamental works. There is a very singular marble found in the bed of a river, at the farm of Blairmachyldach, about three miles south of Fort William, consisting of a black ground flowered with white. It is of a fine close grain, but not very hard. The flowering in it is light and beautiful, like fine needlework, or rather resembling the frosty network upon glass windows, in a winter morning. This I think you will say is sufficient upon the subject of marble.

ALEXANDER. But I have seen very handsome *black marble* chimney-pieces; and as you have said nothing about that kind, I must beg you to tell me where it comes from.

MISS ANGERSTEIN. What is used in England is procured from Bakewell in Derbyshire, near which are two quarries of this mineral. From whence the ancients obtained it I do not know, but it was much prized by them. Marcus Scaurus, who is famed for the large theatre which he built during his edileship, is said to have ornamented it with three hundred and sixty columns of black marble, each thirty-eight feet

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high; and many of the monuments of the ancient Persepolis were executed in it. It is, however, remarkable for an excessively disagreeable smell, which is emitted on rubbing it, or striking it with a hammer. M. d'Avejan, bishop of Alais, a town in the department of Gard, in France, used a kind of black marble for paving the apartments of his palace; but the friction and heat rendered it so fetid, that his successors were compelled to substitute another species of stone in its place. The pavements, however, of many churches, and of the porticoes of several galeries on the continent, are of black marble.

ELIZABETH. You said that the palace of the Escurial, near Madrid, was built by Philip the Second, in performance of one of his vows made at the battle of St. Quentin. How many vows did he make, and what were they?

MISS ANGERSTEIN. He made two vows, both of which he religiously kept; the one was, that if he escaped with life out of this most obstinate and hard-fought battle, he would never again be present at another. The second was, that if St. Lawrence (on whose day, the 10th of August, the battle of St. Quentin was fought) would give him the victory, he would build a palace in honour of him. Tradition says this saint was broiled on a gridiron, in which form the Escurial was built. It was twenty-two years in building, and cost six million of crowns. Eight hundred pillars, eleven thousand square win-

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dows, and fourteen thousand doors were reckoned in it. It was a magnificent, but not a beautiful structure, and has lately been destroyed by fire.

ALEXANDER. What are *calcareous alabaster*, and *calcareous tufa*?

MISS ANGERSTEIN. When we read the description of the Adelsburg Caverns, I explained calcareous alabaster to you, when speaking of stalactites and stalagmites, for they are of this substance. *Tufa* is a calcareous substance, deposited by such water as is impregnated with lime; it clothes, with a stony coat, the smaller branches of trees, leaves, moss, plants, and other substances; and thus preserves them from decay, by protecting them from the action of the atmosphere. Most of the substances termed *petrifactions* belong to this kind of lime. The dropping-well at Knaresborough in Yorkshire, is particularly celebrated for them. An overhanging rock, several yards in depth, has been gradually formed of the calcareous matter which the water holds in solution, and from this rock it incessantly drops into the basin below. The persons who have the care of this place, constantly keep these petrified articles for sale. Even old wigs and hair brooms are subjected to the powers of the water, to furnish objects of attraction to the visitors. There are other springs of this description in Oxfordshire and Somersetshire, and particularly at Matlock in Derbyshire. We are told that at Dalton, on the south side of the Mendip Hills, the workmen not unfrequently find large pieces

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of oak enveloped in blocks of tufa, which are four or five tons in weight.

ELIZABETH. Are there no petrifying springs any where but in England?

MISS ANGERSTEIN. Oh yes, my love! tufa abounds so in some countries, that it is cut and used for building-stones. In the British Museum there is a human skull completely incrusted with stone, which was found in the river Tiber. The warm baths of Hungary are often so thickly coated at the sides and bottom with tufa, that it occasionally fills up the tubes and canals through which they are supplied. If you particularly wish to see a specimen of one sort of tufa, I dare say the cook will be able to indulge your curiosity.

JEAN. Will she, indeed! Why I should not have suspected she knew any thing about tufa.

MISS ANGERSTEIN. Nor I neither: but if you ask her for a piece of the fur out of the tea-kettle, she will probably understand you.

ALEXANDER. Fur out of the tea-kettle! Is that tufa?

MISS ANGERSTEIN. Yes; it is said to be a similar deposit from water in boiling. If you wish to see a very beautiful specimen, I will show you a necklace, cross, earrings, brooch, and bracelets, made out of a spar belonging to this species, which from its silky lustre has derived its name of *satin-spar*.

FANNY. Oh! I have seen them. They are so white and beautiful, and so very glossy.

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MISS ANGERSTEIN. It is susceptible of a very fine polish. It was first discovered in Cumberland, and from hence is frequently denominated Cumberland stone; but it has since been found in various other places in Britain.

ALEXANDER. And is that tufa?

MISS ANGERSTEIN. Not exactly tufa; but a variety of the same species.

ALEXANDER. What is *gypsum?*

MISS ANGERSTEIN. You are already acquainted with it under another name, *alabaster;* which, if you recollect, I told you was the product of the union of the sulphuric acid with lime.

ALEXANDER. Yes, I recollect that; but I was not aware it had two names. I also recollect that *fluor spar* furnishes the *fluoric acid;* but I hardly know what fluor spar is.

MISS ANGERSTEIN. It is a mineral formed by the combination of *lime* with *fluoric acid*, which occurs in several parts of Derbyshire, where it has the name of *Blue John*, and where it is obtained from caverns at a considerable depth beneath the surface of the earth. It is also found in various countries both of the European and American Continent. From its great variety of colour, and its admitting a high polish, this spar is made into several kinds vases of considerable size, columns, and various o namental articles, the manufacture of which give employment to a great number of industrious families

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in Derbyshire. And now I really have done with this genus. I am beginning to feel tired; for I have extended our walk much further than usual, having been so deeply engaged in conversation.

ALEXANDER. Do lean on my arm, if it will be any support to you; for we are still at a considerable distance from home.

MISS ANGERSTEIN. Thank you, dear Alexander. I believe, however, the best way will be to endeavour to forget my fatigue by continuing our chit-chat: therefore we will proceed to the next genus, which is—

ELIZABETH. The *Magnesian genus.*

MISS ANGERSTEIN. Exactly: *magnesia* is a light earth of a perfect whiteness, and is absolutely insipid: the slightly acrid taste occasionally to be found in the magnesia used in medicine, arises from a portion of *lime* which it contains. It is never found quite pure in nature; though in New Jersey, in North America, it occurs so nearly pure, that in the native magnesia of that country, it is combined only with water, or a small proportion of lime and iron. In the water of many springs it is found combined with sulphuric acid, forming sulphate of magnesia, which being extracted from the water of a spring at Epsom, in Surrey, is therefore commonly termed Epsom salts.

ALEXANDER. With which nurse has taken particular care that I should become early acquainted. Have you a list with you of this genus also?

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Miss Angerstein. Yes; here it is, much at your service.

MAGNESIAN GENUS.

Bole	Lemnian Earth	Potstone, or Lapis Ollaris
Meerschaum, or Sea Froth	Jade, or Nephrite	Talc
Fuller's Earth	Axestone	French Chalk
Steatite, or Soap Stone	Serpentine	Asbestus
Figure Stone	Smaragdite	Amianthus
	Mountain Cork	

Emily. I have been listening while Alexander read that paper, and if I may ask any questions, I know which odd name I shall ask about.

Miss Angerstein. Then we will give the little girl leave to propose her question at once, lest it should slip out of her little head. What is the odd name which has taken your fancy, my love?

Emily. *Meerschaum*, or *sea froth*.

Miss Angerstein. And the nature of the mineral is as singular as its name; for when fresh dug it is nearly as soft as wax, but if exposed to a strong heat, it becomes so hard as to yield sparks with steel. It is of a yellowish or greyish-white colour, and is sometimes so light as to float in water. It is found in a fissure of grey calcareous earth, about six feet wide, near Konie in Natolia, where upwards of six hundred men are employed in the digging and preparation of it; and the sale of it supports a monastery of dervises established at that place. The

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workmen assert that it grows again in the fissure, and puffs itself up like froth.

JEAN, *(casting a glance at Alexander.)* I should like to know of what use it is, as so many people are employed to procure it.

MISS ANGERSTEIN. Its principal use is in the formation of the bowls or heads of tobacco-pipes used by the Turks, and the quantity consumed for this purpose is very great. In Turkey, and even in Germany, meerschaum pipes that have been used, are more valued than those newly made, and this solely on account of the colouring they possess. Indeed, there are people in those countries whose sole employment consists in smoking tobacco-pipes till they acquire the favourite tints of colour. By very long use, the heads become black, but if boiled in milk and soap they are soon rendered white again.

JEAN. And is it used for nothing else?

MISS ANGERSTEIN. It is asserted that the Turks spread meerschaum on bread, and eat it as a medicine; and that they cover with it the heads of dead bodies, previously to interment. As it lathers with water like soap, it is used by the Turkish women for washing their hair; and as it absorbs oily matter, it is occasionally used as Fuller's earth is with us, for the cleansing and scouring of cloth. Pliny tells us that a kind of bricks were made by the ancients, so light that, when dried, they would float in water, and describes them to have been made of

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a spongy kind of earth, and to have had some resemblance to pumice-stone. Bricks of a similar description have been lately made of a mineral substance, found near Sienna in Italy, and which is supposed to be meerschaum.

ELIZABETH. I should not like to live in a house built of such light materials, for it might be blown away during one of our stormy nights. Has meerschaum ever been found in Scotland?

MISS ANGERSTEIN. I believe not; but a kind of meerschaum has lately been discovered, in veins, in the serpentine of Cornwall.

ALEXANDER. As you have just mentioned serpentine, and it is also in the list, perhaps you will tell us what it is like, for I have no idea what sort of stone it is.

MISS ANGERSTEIN. *Serpentine*, when polished, has a near resemblance to marble, and is of a dark-green colour, sometimes reddish, variously streaked and spotted with lighter green, red, brown, and yellow; and there are few stones likely to prove more valuable in ornamental architecture, both for beauty and durability. It takes a high polish, and is too hard to suffer the same inconveniences of being scratched or broken as marble, and its colours are said to be indestructible; and such is the size of many of the blocks of serpentine, that columns of almost any dimensions may be wrought out of them. Its name is derived from some of the varieties appearing coloured and spotted like a serpent's skin.

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ALEXANDER. It must be a beautiful stone; but where is it found?

MISS ANGERSTEIN. Near Bayreuth and Zöblitz in Saxony; in some districts of Cornwall; about six miles west of the Parys copper-mines in the Island of Anglesea; at Portsoy in Bamffshire; and at Cloghan Lee, in the county of Donegal, Ireland.

ELIZABETH. I am more anxious to hear about the asbestos than almost any thing else in the list.

EMILY. I want to know whether Portsoy marble is the same as the serpentine found there?

MISS ANGERSTEIN. It is but another name for the same substance. The serpentine from the Island of Anglesea is also frequently called *mona* marble, from the ancient name of the island.

ALEXANDER. Now then for Elizabeth's enquiry, the *asbestos*.

MISS ANGERSTEIN. I ought to ask you for an explanation of the word, you being the only classical scholar amongst us; but to save time, I shall just mention that asbestos is derived from the Greek language, and signifies, that which is inconsumable. This mineral, and particularly a silky variety of it, in long slender filaments, called *amianthus*, was well known to the ancients. They made it into an incombustible kind of cloth, in which they burned the bodies of the dead, and by which means they were enabled to collect and preserve the ashes without mixture.

JEAN. How could they weave a stone into cloth?

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Miss Angerstein. You forget, my love, that I told you the amianthus, of which the cloth was made, was in long slender filaments, or would at least separate into them. In the manufacture of this cloth they were not able to weave the asbestos alone; but in the loom were obliged to join with it linen or woollen threads, which were afterwards burnt away.

Fanny. How very odd that the cloth did not all burn away! I should have expected to see it a cinder.

Alexander. Why, I have read, Fanny, that Pliny, the Roman naturalist, had himself seen tablecloths, towels, and napkins of amianthus taken from the table of a great feast, thrown into the fire, and burned before the company, and that by this operation they were much better cleansed than if they had been washed.

Elizabeth. And is it of no other use than this?

Miss Angerstein. In the Island of Corsica asbestos is advantageously employed in the manufacture of pottery. Being reduced into fine filaments, it is kneaded with clay; and vessels made of this mixture are said to be lighter, less brittle, and more capable of sustaining sudden alterations of heat and cold than common earthenware.

Jean. Where is it obtained? and what is it like?

Miss Angerstein. It is a greenish, or silvery-white mineral, of fibrous texture; and is found in many mountainous countries of the continent, in the Island of Anglesea, and in Scotland.

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ELIZABETH. Then there is no cloth now in existence made from the amianthus; so that all we know of it is from ancient authors.

MISS ANGERSTEIN. Sir James Edward Smith, when at Rome some years ago, saw a winding-sheet of amianthus in the museum of the Vatican. It was coarsely spun, but as soft and pliant as silk. The person who attended him set fire to one corner of it, and the same part burned repeatedly with great rapidity and brightness, without being at all injured. This interesting relic was discovered in the year 1702, in a funeral urn, and contained burned bones, together with a quantity of ashes. It was nine Roman palms long, and about seven in width; and had been deposited in the library of the Vatican by order of Pope Clement the Eleventh. Some time ago, before the sale of Bullock's Museum in the Egyptian Hall, London, I saw a small specimen of amianthus cloth.

ELIZABETH. I wish I had been with you!

MISS ANGERSTEIN. It was before you were born. I have now told you all I know of asbestos. We may, therefore, as well say what little is to be said about the last earth in this class, *thorina*, for I am happy to find myself so near home.

ALEXANDER. From this introductory observation, I fear thorina will not prove amusing.

MISS ANGERSTEIN. So little is known of it, that I shall pass it over with merely observing it was discovered at Finbo, near Fahlun in Sweden; and has

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been named thorina, from the Scandinavian deity, Thor.

ELIZABETH. Before we go in, may I ask you what sort of measure *a palm* is, which you mentioned when speaking of the amianthus winding-sheet in the Vatican?

MISS ANGERSTEIN. It is a measure of three inches, I believe, my dear. How very glad I shall be to sit down and be quiet, for I am tired both of walking and talking. Be quick!

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CHAPTER IX.

"My dears," said Miss Angerstein, when they met the next morning, "as we have now finished the first class of minerals, I give you notice that I shall not enter into such minute descriptions with the other three, or I shall not complete my slight sketch of mineralogy before your brother is obliged to leave us again for Eton.

"How very sorry I am to hear this!" said Jean.

Miss Angerstein. But this resolution is unavoidable, my dear Jean; for were I to go on as we have hitherto done, I should not come to the end of the metallic class before this time next year; and your papa must have a fresh supply of stationery, to provide you with common-place books, in which to note down the subjects of our conversations. But if you wish it, I will point out such books in your papa's library as will furnish you with all that I should tell you, and much more, in all probability.

Alexander. Yes; time is indeed very precious now, for the holidays are fast wearing away. Never before did they pass so pleasantly or so rapidly; and as long as I live I shall look back upon them with de-

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light. My sisters have all been so good-humoured and obliging; dear grandmamma has so greatly enjoyed her Bath chair; my father and mother appear so satisfied with my conduct, since I have been at home; and you have so obliged me, by allowing me to join your walking-party, and so interested me by your account of my favourite science of mineralogy, that my time has been passed in one continued round of pleasure. There never was a happier home than mine!

Miss Angerstein. May you always think so, my dear boy! but that it may continue so, will very greatly depend upon yourself. Your parents are now satisfied and pleased with you, because you have proved to them by your conduct, (while separated from them by a distance of some hundred miles,) that you are desirous of paying every attention to their wishes. Time has passed happily and pleasantly, because all your employments have been rational. I quite agree with you, that the month you have passed at home has been a very happy one; and though, in all probability, you will be far av
before another has slid by, yet the recollectio
past pleasure will stimulate you to greater exe
that your next holidays may be equally agreeab

Alexander. Oh! I shall often think of all
have said to me, and when we meet again I l
you will find I have benefitted from it.

Miss Angerstein. Now then we will proce
to our *second class*, which contains *saline minerals*.

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In this paper you will find the genera, and a few minerals belonging to each. But can either of you recollect what you before learnt of the second class of minerals?

JEAN. I can tell you. *Saline minerals* are such as have a pungent taste, and are heavier and softer than earthy minerals, and partly transparent; as, common salt, rock salt, sea salt, alum, vitriol, capillary salt, nitre or saltpetre, soda, borax, &c.

MISS ANGERSTEIN. Very well indeed, Jean: your memory is a good one, and you must have well learnt what I gave you.

JEAN. Knowing that we were to begin this class to-day, I looked it over last night, and refreshed my memory.

MISS ANGERSTEIN. I like your candour, my dear little girl. It is a proof of a generous mind not to accept of undeserved praise; but I am still equally inclined to praise you now for your diligence and attention, in looking over the lists already given you. What is *a salt*, Alexander?

ALEXANDER. Indeed I cannot tell you, but perhaps you will be so good as to tell me.

MISS ANGERSTEIN. The chemical explanation of it is, that any compound resulting from the union of an acid with an alkali, earth, or metal, is termed *a salt.*

ELIZABETH. I know what earths and metals are, but I do not know what an alkali is.

MISS ANGERSTEIN. The term *alkali* is Arabic,

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and is expressive of the acrid, saline residue left in the ashes of the plant called *kali*, after its combustion in the open air, and which not being capable of volatilization by moderate heat, was termed a *fixed* alkali. But there is another alkali, differing essentially in composition from the fixed alkalies, but agreeing with them in certain chemical properties; and which, being volatilizable at a moderate heat, is therefore termed *volatile* alkali.

ALEXANDER. Which are the *fixed* and which the *volatile* alkalies?

MISS ANGERSTEIN. The *fixed alkalies* are the vegetable or potash, and the mineral or soda. The *volatile alkali* is Ammonia; so called, because the salt from which it is extracted was formerly imported from Ammonia, a region of Lybia in Africa.

ELIZABETH. Then we have heard of the alkalies before, because you told us that soda or potash were necessary to vitrify the sand or flint in the manufacture of glass; but we were not acquainted with their nature.

MISS ANGERSTEIN. In the *second class* are generally reckoned six genera, which I shall give you. I must however tell you, that mineralogists are by no means agreed upon this division; and that, when you come to consult different writers upon this science, you will meet with a great variety of arrangements. The one I have selected I thought the simplest and best suited to your young minds. Read this paper, Alexander.

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SECOND CLASS.

GENUS 1.—*Sulphates;* containing native vitriol, native alum, mountain butter, capillary salt, native Epsom, and Glauber salts.

GENUS 2.—*Nitrates;* nitrate of potash, native nitre.

GENUS 3.—*Muriates;* rock salt, common salt, sea salt, native sal Ammonia.

GENUS 4.—*Carbonates;* native soda, native magnesia.

GENUS 5.—*Borates;* boracite, borax.

GENUS 6.—*Fluates;* cryolite.

JEAN. They are very uncouth names, but I hope they will prove amusing, and that will reward us for the trouble of learning such hard words. What will become of you, Alexander? how will you put this list into your head?

ALEXANDER. Much in the same way that I have done other things of equal difficulty. I must, in the first place, enquire what we are to understand from *sulphate, nitrate, muriate,* &c.

MISS ANGERSTEIN. Each salt derives its name from its elementary principles, or constituents; so that all these words imply a knowledge of the composition of the salts. The three alkalies, the alkaline earths, and the metals, are called *salifiable bases* or *radicals,* and the acids *salifying principles:* the name of each salt is therefore composed both of that of the acid and the salifiable base. Thus, for instance, all those salts which are formed by the combination of

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the *sulphuric acid* with any of the salifiable bases, are called *sulphates*, and the name of the radical is added for the specific distinction of the salt: if it be *potash*, it will compose the sulphate of potash; if *Ammonia*, sulphate of Ammonia, &c.

ALEXANDER. Now then, I think I fully understand; and to convince you I do, I shall explain one or two of these genera. A *nitrate* is the combination of *nitric acid* and a base, say copper: this will form a *nitrate of copper*. *Muriatic acid* and a base form *muriates*.

ELIZABETH. Stop, Alexander; Jean and I are willing to try our skill. *Carbonic acid* and a base form *carbonates; boracic acid* and a base form *borates*.

JEAN. *Fluoric acid* and a base form *fluates*.

MISS ANGERSTEIN. You understand this matter sufficiently for our present purpose. At some future time I will lend you that most instructive and amusing work, "Conversations on Chemistry," where you will find the subject more fully explained.

ALEXANDER. I have often heard of vitriol, but I scarcely know what it is.

MISS ANGERSTEIN. There are three sorts of vitriol. *Green vitriol*, or *sulphate of iron; blue vitriol*, or *sulphate of copper;* and the *white vitriol*, or *sulphate of zinc*. These are called *metallic salts*.

ELIZABETH. Are they ever found in a pure state in nature, or are they manufactured?

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Miss Angerstein. Green vitriol, or copperas, is occasionally found in grottoes, caverns, the galleries of mines, and other places. Blue vitriol is sometimes found in a state of concretion, or in the form of powder disseminated over the surface of stones that have been in contact with water impregnated with vitriol. White vitriol also occurs occasionally in a natural state, in mineral repositories that contain *blende*, (an ore of zinc,) and is found at Holywell in Flintshire, and in some parts of Cornwall, but they are more frequently artificial preparations. Green and blue vitriol are much used by dyers, artists, and manufacturers, and white vitriol in medicine. A fine white colour, called *zinc white*, is also prepared from it. Dyers also use a considerable quanity of it to deepen the colours produced by madder, cochineal, &c.

Alexander. Alum and Epsom salts we have already had explained to us. Alum is procured from a species of slate; and Epsom salts are produced by a combination of sulphuric acid with magnesia.

Elizabeth. Then Epsom salts must be a *sulphate* of magnesia. Am I right?

Miss Angerstein. Perfectly so, my love; and I am now sure that you understand what we have been talking about. Now, Jean, tell me what *Glauber salt* must be, as it consists of soda combined with sulphuric acid.

Jean. Sulphate of soda, I think; and if I am

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right, will you tell me why it is called *Glauber's* salt?

Miss Angerstein. From having been originally discovered by a German chemist whose name was Glauber. It is now found in an efflorescent state, on meadow-ground, at Egor in Bohemia, and on the walls of old galleries in mines at Grenoble in France. It is abundant in the ashes of some kinds of vegetables, especially of sea-weeds. The waters of the Mediterranean yield a great proportion of it; and that used for commercial purposes is chiefly prepared from sea-water, or from common table-salt.

Emily. Fanny and I want to know what *mountain butter* can be. Will you tell us, dear Miss Angerstein?

Miss Angerstein. It is a species of alum, which in its native repository is nearly as soft as butter, and has something of the appearance, from which it has its name.

Alexander. Potash, I think, you said was a salt obtained from the ashes of vegetable substances; but why was it called *potash?*

Miss Angerstein. This appellation was given to it from its having been formerly prepared in large iron pots. Pearlash is this salt rendered whiter and purer by being made red hot.

Alexander. Nitrate of potash, mentioned in the list, must be a combination of nitric acid and potash; but is there no simpler name for it?

Miss Angerstein. Yes; *nitre* or *saltpetre.*

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JEAN. Oh! that we all know by sight; for we have often begged a little from cook, to throw upon the fire, it sparkles so prettily.

ELIZABETH. And by taste too; for when we have sore throats nurse always gives us nitre balls to suck. Where does it come from?

MISS ANGERSTEIN. It is found incrusted on the surface of the earth, in some parts of India, Africa, and Spain, and in such abundance as to admit of being swept off at certain seasons of the year, twice or three times a-week. In our own country it not unfrequently occurs in a state of white efflorescence, on old plaister walls that are sheltered from the rain. But as immense quantities of nitre are annually required for the purposes of war, it has been found necessary to adopt artificial modes of procuring it. In several districts in the East Indies there are places called *saltpetre grounds*. From these large quantities of the earth are dug, and put into cavities through which water is passed. This brings away with it the salt which the earth contains, and which is afterwards separated from the water by boiling.

JEAN. Why is so much nitre wanted in war? Of what use is saltpetre?

MISS ANGERSTEIN. It is a principal ingredient in gunpowder, which is a composition of saltpetre, sulphur, and charcoal, mixed together, and usually granulated. The invention is generally ascribed to Bartholdus Schwartz, a monk of Goslar, south of Brunswick, in Germany, about 1320; but some

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maintain that it was known much earlier in many parts of the world; and that our famous Roger Bacon knew of gunpowder near a hundred years before Schwartz was born.

EMILY. Who was Roger Bacon?

MISS ANGERSTEIN. A Franciscan monk, born at Ilchester in Somersetshire, in 1214, and died in 1294; a very learned man, who made many useful and scientific discoveries.

JEAN. You said gunpowder was usually *granulated*, which I believe means *made into grains*. But how can this be done?

MISS ANGERSTEIN. The ingredients are first reduced to a fine powder separately, then mixed together with water, so as to form a thick paste, which, when dried a little, is placed upon a kind of sieve full of small holes, through which it is forced. By this process it is divided into grains, after which it undergoes some other operations before it is ready for use.

JEAN. Now then we come to the *muriates*. With most of those mentioned in the list we have a superficial acquaintance, which I hope will now become more intimate. Will you not begin with common salt?

MISS ANGERSTEIN. It makes no difference to me; so if it pleases you, we will now discuss *muriate of soda*, or common salt; and as Emily and Fanny have accompanied us, and been very attentive to all that has passed, I dare say one or the other can tell me what it consists of.

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FANNY. How very kind you are to let us little girls talk to you about such things. I think I can tell you. Soda is the salifiable base, and muriatic acid is the salifying principle.

ALEXANDER. Well done! little philosopher: why you have answered as scientifically as even my learned self could have done.

MISS ANGERSTEIN. And much more so than your learned self did, when a similar question was put to you. It is very well answered, my little girl; and I now recommend that you and Emily should run and gambol about, for you are too young yet to walk steadily, as we *old folks* do.

EMILY. May we not walk with you a little longer? We want to hear what you are going to tell about salt.

MISS ANGERSTEIN. I have no objection to it, my love; only when you feel tired of our grave discussions, take your departure quietly, and have a run. Common salt, or muriate of soda, though found in some countries in a solid and massive state, is for the most part an artificial preparation from sea-water, and from the water of salt lakes and brine springs. It is used in various ways in domestic economy; also for glazing the surface of coarse earthenware, and in several processes of dying. When this substance is dug out of the earth, it has the appellation of *rock salt*. Its beds are mostly beneath the surface of the ground, but sometimes rise into hills of considerable elevation. At Cordova in Spain, a hill between four and five hun-

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dred feet in height is entirely composed of this mineral. The most celebrated salt-mines are those of Wielicska, about five miles from the city of Cracow in Poland; those of the Tyrol; of Castile in Spain; and of Cheshire in England. In the province of Lahor in Hindostan, is a hill of rock salt of equal magnitude with that of Cordova. The mines of Iletski in Russia yield vast quantities of this substance. It is so plentiful in the deserts of Caramania, and the air so dry, that it is there used as a material for building. It forms the surface of a large part of the northern desert of Lybia, and is found in great abundance in the mountains of Peru. One of the largest salt-mines in Germany is that of Hallein, near Saltzburg, in which the salt is hewn out of subterraneous caverns of a considerable range, and exhibits almost every diversity of colour, as yellow, red, blue, and white; in consequence of which it is dissolved in water, to be liberated from its impurities, and afterwards recrystallized.

ELIZABETH. I hope you will give us a description of the salt-mines of Wielicska; for though I have read of them, I should like to hear you tell us about them.

MISS ANGERSTEIN. To do justice to the subject would take up our whole morning; so I shall refer you to *Les Veilleés du Chateau*, and merely mention, that these mines alone, are supposed to contain more salt than would be sufficient to supply the wants of the whole world for several thousand years; that

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the length of the great mine is six thousand feet, from east to west; its breadth from north to south, two thousand; its greatest depth eight hundred feet. But the veins of salt are not limited to this extent; their depth and length from east to west being yet unknown, their breadth from north to south being only as yet determined.

ALEXANDER. What a wonderful place it must be! I think I have read that some of the miners had not only been born there, but had never seen the light of day.

MISS ANGERSTEIN. Many of them are born there, and never stir out; others, however, have occasional opportunities of breathing the fresh air in the fields, and enjoying the light and warmth of the glorious sun. In several parts of the mine huge columns of salt are left standing, to support the rock, and these are very fancifully ornamented. But the most curious object in the inhabited part of the mine is a statue, which is considered by the immured inhabitants as the actual transmutation of Lot's wife into a pillar of salt; and in proportion as this statue appears dry or moist, the state of the weather above-ground is inferred.

JEAN. Poor creatures! how ignorant they must be, or they would not suppose such a thing. Where are the brine springs?

MISS ANGERSTEIN. In various parts of the world; but in England the principal are in Cheshire, Cumberland, Staffordshire, and Worcestershire, from

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which salt is obtained by evaporating the water. Cannot either of you repeat Dr. Darwin's poetical description of the salt-mines of Cracow? Try Elizabeth, and recollect them.

Elizabeth.

" Thus caverned round in Cracow's mighty mines,
With crystal walls a gorgeous city shines;
Scoop'd in the briny rock long streets extend
Their hoary course, and glittering domes ascend;
Down their bright steeps immerging into day,
Impetuous fountains burst their headlong way,
O'er milk-white vales in ivory channels spread,
And wandering seek their subterraneous bed.
Form'd in pellucid salt, with chisel nice,
The pale lamp glittering through the sculptured ice,
With wild reverted eyes fair Lotta stands,
And spreads to heaven in vain her glassy hands;
Cold dews condense upon her pearly breast,
And the big tear rolls lucid down her vest.
Far gleaming o'er the town transparent fanes
Rear their white towers, and wave their golden vanes;
Long lines of lustres pour their trembling rays,
And the bright vault returns the mingled blaze."

ALEXANDER. *Native sal Ammonia:* has it no other name?

MISS ANGERSTEIN. That is the name by which it is generally known; but its chemical appellation is *muriate of Ammonia,* which was found by the ancients in great abundance amongst the sands near the temple of Jupiter Ammon in Africa. It is at present found in Persia, and, accompanying sulphur,

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amongst volcanic matter near Mount Vesuvius. It was formerly imported from Egypt in the form of conical loaves, or of round cakes, which were convex on one side, and concave on the other; but it is now made in Europe, by burning at the same time soot, bones, oil, and salt. The deposit formed by the vapour consists of sal ammonia with other substances, from which it is separated by a subsequent process.

JEAN. And is this useful to the dyers also?

MISS ANGERSTEIN. It is most useful to them in brightening some particular colours. It is also occasionally used in medicine, in the manufacture of shot, &c.

ALEXANDER. Now we come to the fourth genus, *carbonates*, the first of which is *native soda*.

MISS ANGERSTEIN. It is so; and the next, *native magnesia*. But we will begin with the soda.

ELIZABETH. But what do you mean by the term *native* prefixed to some salts?

MISS ANGERSTEIN. A *native* salt is one that is found *crystallized* in nature; and a *native* metal is one found in nature in a *metallic state*.

ELIZABETH. Thank you, ma'am, for this explanation; for I looked yesterday into "Blair's Grammar of Chemistry," and many other books, and could find nothing about it. But I interrupted you when you were going to speak of soda.

MISS ANGERSTEIN. But I am always happy to answer any enquiry after useful information. Now, however, we will proceed. *Native soda, carbonate of soda* or *natron*, consists of soda in combination with carbonic acid, and is of a greyish colour, soluable

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in water, and has a disagreeable *alkaline* taste. It is found in Egypt, on the surface of the earth, and particularly near the margins of lakes; from which, during the summer season, the water is evaporated by the heat of the sun, leaving a bed of *natron* frequently about two feet in thickness. This is broken with wedges and hammers, and packed up for sale in the European markets. In the neighbourhood of Debreczin in Hungary, it is found in considerable quantities, efflorescent on a heathy soil; and in Bohemia on a decomposed rock, where it is annually collected in the spring of the year. Natron is also found near Naples, in Persia, Bengal, and China. It also exists in solution in many mineral waters.

ALEXANDER. I know that soda is used in the making of soap, but I always thought before that it was procured from the ashes of sea-weeds.

MISS ANGERSTEIN. You are now confounding *soda*, properly so called, with the *carbonate* of soda or *natron*, of which we have been just speaking. The *soda* of commerce is obtained from the sea-water, or from the ashes of different kinds of plants that grow on the sea-shores; but particularly from that called *salsola soda*, which is found in great abundance on the coasts of the southern parts of Europe, and from which it has its name. It is sometimes called *barilla*, from the salsola soda being so denominated in Spain.

JEAN. I have very often heard of barilla, but I never before knew what it meant.

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Miss Angerstein. That was your own fault, my love: you have always kind friends around you, who would either answer your enquiries, or direct you to books where they are explained. But to continue. This alkali is of essential use in the arts. When melted with sand or flint it forms——What does it form, Fanny?

Fanny. Glass.

Miss Angerstein. Yes, it forms glass; and answers much better for this purpose than potash. In conjunction with oil and lime it is employed in the manufacture of soap; and it is used as a substitute for soap in the cleaning and bleaching of linen, flannel, and worsted goods. *White soap* is made of pure oil, lime, and soda. *Yellow soap* is made of tallow, resin, and soda. *Soft soap* is a combination of oil and other ingredients, with potash instead of soda.

Alexander. Now you have kindly explained my mistake to me, will you resume your account of *natron*, and tell us its uses?

Miss Angerstein. They are very similar to those of soda, being employed in the manufacture of soap and glass. On the continent it is administered as a medicine. The ancients sometimes employed a mixture of natron for soaking their seed-corn, under an impression that, when afterwards committed to the earth, it would thereby be rendered more fertile. The ancient Egyptians are said to have made great use of natron for the preservation of dead bodies, by

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immersing them in a strong solution of it for several months previously to their being embalmed.

ELIZABETH. And does all the natron so used come from Africa?

MISS ANGERSTEIN. Oh no, my love. Large quantities of this salt are imported into England, by the East India Company's ships, from China, and other parts of the East. Native magnesia I described to you when speaking of the earth of that name, therefore I shall say nothing more of it now.

JEAN. In which case we proceed to the fifth genus, *borates*.

MISS ANGERSTEIN. *Borax* is a salt composed of boracic acid (which I slightly noticed in our early conversations) and soda; and although it has long been known as an article of traffic, there is scarcely any production with the origin of which we have been, till lately, less acquainted. It is found in a native, though impure state, in a mountain lake, situated about fifteen days' journey from the capital of Thibet in the East Indies. This lake is so encompassed with hills as to have no stream either falling into it or flowing from it. The water is salt to the taste, and contains both borax and common salt; and the edges and shallow parts are covered with a stratum of this substance, which is dug up in considerable masses for exportation. It has here the name of *tinkal*, and is usually brought into Europe enveloped in a kind of fatty substance. The mode of refining it was for a long time kept by the

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Dutch and Venetians a most profound secret: when refined it is called *borax*.

ALEXANDER. It seems curious stuff. Now then for its uses.

MISS ANGERSTEIN. Its uses are numerous, I assure you. It is employed as a *flux* for metals, being found to produce a more limpid fusion than any other substance. For the same reason it is made an ingredient in the finest kinds of glass, and particularly in some of the coloured glass pastes, which are manufactured in imitation of gems. But its chief use is, to jewellers and goldsmiths, to facilitate the soldering of gold and silver. It is also used in medicine.

ELIZABETH. What is meant by a *flux*?

MISS ANGERSTEIN. Any substance mixed with a mineral to promote fusion or melting, is termed a *flux*, and for this purpose borax is very valuable. *Boracite*, or *Borate of Magnesia*, is so rare a mineral, that as yet it has only been found at Luneburg in Lower Saxony, in a mountain composed almost entirely of foliated gypsum, in which it is imbedded in detached crystals. Of the sixth and last genus, *fluates*, very little is known. *Cryolite* or *fluate of soda and alumine*, was brought from Greenland to Copenhagen; but nothing has been discovered concerning it, but its constituent parts, which are soda, alumine, fluoric acid, and water.

ALEXANDER. And so ends the second class. I have not been so much interested with it as I was

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with the first; but I promise myself more pleasure from the third, which, as we are but a short way on our walk, I hope you will tell us something about. Have you the magic list with you?

Miss Angerstein. I did not think we should want it this morning; but if you have pencil and paper, I will tell you what to write, and you may make a list—a magic one, if you so please to call it—for yourself. Are you ready?

Alexander. There: I have pointed my pencil, and got the back of an old letter. I shall perch myself upon this stone, and make a table of my hat. Now I am very comfortable. I regret exceedingly, ladies, that you should be obliged to stand; but as there are no other stones, all I can do is to write as fast as our kind friend will dictate, and vacate my seat. Now, dear Miss Angerstein, I have written—

Miss Angerstein. Class third, *combustibles.*

Genus 1.—*Sulphur;* native sulphur, volcanic sulphur.

Genus 2.—*Bituminous;* petroleum or mineral oil, mineral pitch, naphtha or rock oil, elastic bitumen or caoutchouc, asphalt or solid bitumen, common coal, cannel coal, jet or pitch coal, amber.

Genus 3.—*Graphite;* diamond, mineral charcoal, plumbago or black-lead.

"Now put on your hat, and let us walk onwards. I must mention to you, before we proceed to converse upon the several articles in the list, that com-

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bustibles include both the hardest and softest of the mineral substances; and that whilst most of the metals, whose properties are altered by combustion, acquire an increase of weight, yet the weight of combustible substances is sensibly diminished by the same process. Every other particular concerning them will be best explained as we go on.

ALEXANDER. That is as much as to say, you are now ready to answer questions. Will you therefore be kind enough to begin with the first genus?

MISS ANGERSTEIN. *Sulphur* is a dry, brittle substance, of different shades of yellow, and highly inflammable. *Native sulphur* is of a greenish yellow colour, and is of about twice the weight of water. It occurs in beds of gypsum, and also, though but rarely, in the veins of primitive mountains. It is found in the mountains of South America, in the Apennines of Piedmont, in the Glaciers of Mont Blanc, in Spain, Hungary, Poland, and Siberia; it also occurs in certain warm springs in sufficient quantity to form a deposit when in contact with the air.

ELIZABETH. I know that many springs are sulphureous, and I have drank the waters of Strathpeffer in Ross-shire, which I think extremely disagreeable: they are, I believe, reckoned similar to the Harrowgate springs.

MISS ANGERSTEIN. There are many sulphureous springs in the Highlands; but the Strathpeffer are said to be the most valuable on many accounts; and ve proved extremely efficacious in many complaints.

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But to return to our subject. *Volcanic sulphur* is found in Italy, Iceland, and South America. The sulphur of commerce is chiefly obtained from the crater of the ancient volcano at Solfaterra, near Naples. Indeed, this volcanic country every where exhibits indications of the agency of subterraneous fire. Nearly the whole ground is bare and white; and in every part is warmer than the atmosphere during the greatest heat of summer. A sulphureous vapour is constantly emitted from the earth, and sulphur is condensed in various parts, and in great abundance, which is collected, packed in casks, and exported to various countries, but more especially to Marseilles, where it undergoes certain preparations necessary towards purifying and rendering it fit for sale.

JEAN. Do we obtain it from Italy?

MISS ANGERSTEIN. Much of what we use is obtained by the process of roasting copper and other ores, previously to their being smelted. It passes off in the form of vapour, and on being received into chambers constructed for that purpose, is there deposited in a powdery state. The substance thus formed is the *flour of sulphur* of the shops.

FANNY. And the hard brimstone that Sambo has in his dish of water—where does that come from?

MISS ANGERSTEIN. The hard, or *roll brimstone*, is nothing more than the flour of sulphur melted in large pans, and cast in wooden tubes.

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ALEXANDER. And its uses?

MISS ANGERSTEIN. Useful as sulphur is in bleaching, and as an ingredient in gunpowder, its most important application is supposed to be for the production of the *sulphuric acid*, which is so extensively employed in tanning, hatmaking, dyeing, and other arts and manufactures. We will now proceed to the next genus, the bituminous.

ELIZABETH. As I should like to know some particulars respecting every article in the list, I do not know which to select first: I think *naphtha*, or *rock-oil* must be my choice. I have read that it abounds in Persia.

MISS ANGERSTEIN. It does so, my love; and there are copious springs of it at Baku, on the shores of the Caspian sea, also in some parts of Italy, particularly at Monte Chiaro, near Piacenza in Calabria, Sicily, and America.

JEAN. And not at all in Great Britain?

MISS ANGERSTEIN. At Pitchford, in Shropshire, extensive strata, or beds of sandstone are saturated with this mineral fluid, which is obtained from the stone by distillation, and is sold as a remedy for sprains and rheumatism, under the name of *Betton's British oil.*

EMILY. What is naphtha like, in colour and quality?

MISS ANGERSTEIN. It is a yellow or brownish fluid, rather greasy to the touch, and so light as to

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float on spirits of wine. It burns easily with a dense smoke, and leaves very little residium. When exposed to the air it becomes thicker and less fluid.

JEAN. Is it of any great use, or merely a natural curiosity?

MISS ANGERSTEIN. By the Persians and Russians naphtha is taken internally as a cordial. It has been sometimes employed in the composition of varnish and fireworks. In Persia it is burnt in lamps, instead of oil; and in 1822 a spring of naphtha was discovered in the state of Parma, in Italy, which afforded such a quantity as to be sufficient to illuminate the streets of Genoa.

ALEXANDER. And my choice falls on *petroleum*, or *mineral oil*. Does it at all resemble naphtha?

MISS ANGERSTEIN. Like naphtha it is a bituminous fluid, but of a greater consistency, and of a black, brown, or dingy green colour. It exudes spontaneously from the earth, or from clefts of rocks, and is found in nearly all countries, particularly in the East Indies, Italy, France, Spain, Germany, and England. In the neighbourhood of Rangoon, in Pegu, there are several hundred wells of petroleum, which are of a square form, of considerable depth, and each lined with cassia-wood staves. The oil is drawn from them pure, and in a liquid state, and is conveyed thence in small jars. The whole annual product of this district is estimated at more than four hundred thousand hogsheads.

ALEXANDER. This must be a most useful article,

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since so much is exported. For what purposes is it mostly employed?

Miss Angerstein. In Pegu and other parts of the East, petroleum is used in place of oil, for lamps. Boiled with a species of resin, it is employed for painting the timber of houses, and covering the bottoms of boats and other vessels, for which purpose it is considered to be particularly efficacious, by protecting the timber from the attacks of marine worms. It is also much esteemed by the inhabitants of eastern countries, as a lotion in cutaneous eruptions, and as an embrocation in bruises and rheumatic affections. The ancient Egyptians used it in the embalming of dead bodies, and in some countries lumps of earth are soaked in petroleum, and employed as fuel.

Elizabeth. Where is it found in England?

Miss Angerstein. At Colebrook Dale, in Shropshire, there is a spring of petroleum, which was discovered at the depth of about thirty yards beneath the surface of the earth, in digging an archway for the conveyance of coals from a very deep pit. The petroleum was at first found to ooze from between the crannies of the rock, but it soon afterwards poured forth in a considerable stream. The utility of this fluid having been made known, large iron pipes were placed from the spring into pits sunk for the purpose of receiving it. From these pits it is conveyed into immense cauldrons, where it is boiled until it attains the consistency of pitch. Since the first disco-

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very of this substance, three different springs of it have broken out: one of these is near the celebrated iron bridge, and the fluid that issues from it is almost pellucid, but at the same time thicker than treacle. *Mineral*, or *Barbadoes tar*, is an exactly similar fluid as petroleum, but rather thicker. In the West Indies, where it is particularly found, it is applied to many of the same purposes as petroleum, and is likewise used as an external remedy in paralytic disorders.

JEAN. And as it is now my turn, I shall ask my dear Miss Angerstein to tell me whether the mineral *caoutchouc* is really like the Indian rubber we use?

MISS ANGERSTEIN. It has a strong resemblance to India rubber, being in some instances as elastic, and possessing the properties of effacing the marks of black lead, or plumbago on paper. It was first discovered about the year 1786, in cavities of the lead mines of Odin, near Castleton, in Derbyshire, and it has not hitherto been found elsewhere. It seems to be a medium between *petroleum* and *asphalt*, or *solid bitumen*, which may as well be the next article mentioned.

ELIZABETH. I think you seem tired of talking to us so much: let us leave the rest for another day. Remember how very much fatigued you were the other morning; you scarcely recovered it the whole day.

MISS ANGERSTEIN. I was very greatly fatigued, my love; and I shall not easily forget how kindly you assisted me in getting through the day's business,

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by unremitted attention to your own studies, and hearing your sisters their lessons, so as to prevent my speaking. Such conduct, my Elizabeth, endears you to me, and makes all my employments pleasure to me. But I am not tired yet, so I shall proceed to *asphalt*, with which the ancients were well acquainted, and which is nothing more than *mineral tar* in an indurated or hardened state. It is found on the surface of volcanic productions, and floats in solid pieces, and in considerable abundance, on the Lake Asphaltum in Judea, from which it derives its name of Jew's pitch.

ELIZABETH. Is Lake Asphaltum also called the Dead Sea?

MISS ANGERSTEIN. Yes; it is so called, from a notion that the odour arising from the asphalt destroys even birds that fly over it, though late travellers assert that this is not true; and one in particular, Mr. Maundrell, says he saw several birds fly about and over it, without experiencing the slightest injury.

ALEXANDER. You say it was well known to the ancients; how did they use it?

MISS ANGERSTEIN. As asphalt was found near ancient Babylon, there is every reason to believe that the mortar so celebrated among the ancients, and with which the walls of Babylon, and the temple of Solomon were cemented, was nothing more than a preparation of asphalt. Herodotus also informs us, that a composition of heated bitumen, mixed with the

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tops of reeds, was used by the ancients as a cement. This account is confirmed by modern travellers, who have discovered the remains of buildings in which bitumen was formerly employed. It is presumed to be the same substance, which in our translation of the Old Testament is called pitch, and which was used by Noah as an exterior and interior coating of the ark.

ALEXANDER. Of what use is it to the moderns?

MISS ANGERSTEIN. The Arabians dissolve asphalt in oil, and with the mixture smear their horse-harness, to preserve it from the effects of weather and the attacks of insects. In a state of solution it is applied, in several Eastern countries, as a covering for timber and the bottoms of ships. In France it is manufactured into a substance which is in considerable request for greasing the wheels of carriages. It is used by the makers of watch-dials, who mix it with lamp-black and oil of turpentine; but its chief use is as an ingredient in certain varnishes, and particularly in the varnish used by copper-plate engravers.

JEAN. And do they import it from Asia alone for all these various purposes?

MISS ANGERSTEIN. It is found in the province of Neufchatel, and many parts of the Continent of Europe; also in several parts of America, and in the Island of Trinidad.

ELIZABETH. Now then we come to *coal*, with

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which we have been acquainted from our cradles, and yet never knew till very lately what kind of production it was.

Miss Angerstein. That is too often the case with us all. We are contented with being aware of the particular use to which we apply various things, and make no further enquiry about them. The principal object I have in view in these morning conversations, is not to make you fully acquainted with the three kingdoms, but merely to awaken in your minds a spirit of observation, and to lay the foundation by which you will be enabled to add a superstructure of knowledge in future years. *Coal* is one of the most, if not the very most, valuable minerals we possess. It chiefly occurs in the northern hemisphere, particularly in countries which lie nearly in the same latitudes as Great Britain; in Siberia, Germany, Sweden, France, Canada, and Newfoundland, and in some of the northern parts of China. It is said to be abundant in New Holland; but we have no distinct account of coal in the continent of Africa. No fewer than seventy different kinds of coal are brought to the London market, which differ greatly in value and price. Elizabeth, I hope you can tell me from whence coals are principally obtained in England.

Elizabeth. From the neighbourhood of Newcastle-upon-Tyne, Sunderland, and Whitehaven.

Jean. When we were in Ross-shire with my aunt, one of the cotters talked of not being able to

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burn sea-coal, because it was so dear. What kind of coal is that?

Miss Angerstein. Common coal is so called, my dear, because it is conveyed to London, and many other places, by sea; it is also called pit-coal, because it is dug from mines or pits in the midland counties.

Alexander. When were coals first used as fuel?

Miss Angerstein. Pennant says, coals were known to the Britons before the arrival of the Romans, who had not even a name for them; though Thæophrastus, a Greek philosopher and pupil of Aristotle, who died in the hundred and seventh year of his age, (B. C. 288,) describes them very accurately, and even says they were known to workers in brass. Mr. Brand, in his "History of Newcastle-upon-Tyne," says that they were burnt by the Romans. The Anglo-Saxons knew and partly used them. Mr. Brand, however, observes they were not mentioned under the Danish usurpation, nor under the Normans. The first public mention of coal that we meet with is in the year 1239, when Henry the Third confirmed the charter granted by John, his father, to the inhabitants of Newcastle, to dig coals in the common soil without the walls of that town. In 1306 they were prohibited in London as a nuisance; but used in the palace in 1321, and became soon after an important article of commerce. In 1512 they were not always used, because not having got to the

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main stratum, people complained that they would not burn without wood. The best coals were then sold at five shillings per chaldron. In the seventh century no trade but blacksmiths used them, and they were wholly confined to the lower orders, who could not afford to buy wood. They were then hawked about the streets in sacks upon men's shoulders.

JEAN. Why were they considered as a nuisance, and forbidden to be burnt in London?

MISS ANGERSTEIN. From the supposed tendency of their smoke to corrupt the air.

ALEXANDER. Is not the gas which is now so much used for lighting the streets and shops in London, produced from coals?

MISS ANGERSTEIN. Yes; by distillation. The first public display of *gas-lights* was made in the year 1802, (on the occasion of the rejoicing for the peace of Amiens,) at the foundery belonging to Messrs. Boulton and Watts, at Birmingham. You may convince yourself of this fact, by an easy little experiment.

ALEXANDER. Pray tell me how: I am so very fond of experiments.

MISS ANGERSTEIN. Fill the bowl of a tobacco-pipe with common coal, pounded quite small, covering it closely over with a stiff clay, which must be gradually dried. When the clay is quite dry, put the bowl of the pipe into the fire, and there heat it gradually. In a few minutes a stream of gas will issue from the end of the pipe, which may be set on

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fire with a piece of paper, and will burn with a bright flame.

ALEXANDER. Oh, I must try that! Will the coal be entirely consumed?

MISS ANGERSTEIN. When all the gas is disengaged, there will be found in the bowl of the pipe the remains of the coals, in the form of *coke*.

JEAN. I have often read of coke, but I never knew what it really was: I supposed it was some sort of coal.

MISS ANGERSTEIN. *Coke* is coal converted into a kind of cinder, by being divested of its humid, acid, and bituminous particles, by a process called *charing*. It is employed where intense heat is requisite, as for the smelting of iron ore, and likewise where the fumes of coal would be detrimental, as in the drying of malt.

ALEXANDER. And what is *culm*?

MISS ANGERSTEIN. The refuse, or dusty coal, produced in working the common coals, is usually termed *culm*. It contains much earthy matter, will not kindle in an ordinary fire-place, but produces a considerable heat and flame in a furnace, where a strong current of air is introduced. In England it is exempt from the high duty imposed upon other coals, and is sold at a very low price. It is chiefly used for burning lime, making salt, and in steam-engines.

ELIZABETH. My aunt has a specimen of coal which does not stain the fingers. I cannot recollect

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what name she gave it, but she told me it came from Lancashire.

Miss Angerstein. It must have been *cannel-coal,* of which there is an entire stratum, about four feet in thickness, in the neighbourhood of Wigan, in Lancashire. It is also found in the neighbourhood of Edinburgh, and at Muirkirk in Ayrshire, where it has the name of *parrot-coal. Kilkenny coal* is said to belong to this variety, which is also called *stone-coal,* or *glance coal.*

Elizabeth. Is it used for fuel, like the common coal?

Miss Angerstein. Yes, my dear: it is highly inflammable, and burns with a cheerful, brilliant flame, but it does not cake like pit-coal, and soon burns away. As it is susceptible of a fine polish, and admits of being turned in a lathe, it is formed into various useful and ornamental articles. I have also read that the choir of the cathedral church at Litchfield is covered with plates of this coal, alternately with black marble.

Jean. Now then there is only one more article in this genus, and then we shall know where mamma's pretty black necklace came from, for that is made of jet. But in the list it is also called *pitch-coal.* Can it be a kind of coal?

Miss Angerstein. *Jet* is a species of coal, and belongs to the variety called *pitch-coal.* It is frequently cast ashore on the eastern coasts of England, particularly near Lowestoff in Suffolk, and in some

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parts of Yorkshire, where many persons employ their leisure in searching for it, and forming it into various kinds of trinkets. It is found in the Prussian amber-mines, and is there called black amber; also in several places in France, Germany, Saxony, and Spain. In different parts of the globe, the trunks of trees which have been long buried, have passed into the state of jet, and in almost all these trees may be traced the distinctive characters of the species to which they belong. They are more or less brittle, more or less unctuous, according to the species, the degree of alteration, and the nature of the soil. They are not all adapted to the tool of the workman; if the texture be unctuous, the fibre acquires a considerable degree of softness, is susceptible of being properly wrought, and receives a perfect and beautiful polish.

EMILY. You said jet was the last on the list. I see *amber* after it, and *mellite* or honey-stone.

JEAN. Yes, I know that; but when speaking of the *succinic* acid, which is obtained from amber, Miss Angerstein gave us a full account of it; and of mellite or honey-stone, when speaking of the *mellitic* acid.

EMILY. Very true, Jean, so she did. Do you know, I had forgotten it.

JEAN. Because you are not so interested in these conversations now, as you will be by and bye, when you are older.

EMILY. Very likely; but I am very fond of them now.

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ALEXANDER. I suppose we leave off here, as we are just at home, and you are tired.

MISS ANGERSTEIN. I think we may as well, and begin with the *graphite genus* the next time.

ALEXANDER. May I, however, ask you what coal is supposed to be; or from what does it derive its origin? We all know it well by sight, and we are now tolerably well acquainted with its uses, (thanks to your kind explanations,) but I am still ignorant of its real nature.

MISS ANGERSTEIN. The bituminous substance called coal, though ranked among minerals, because its basis is pure *carbon,* is now by many believed to be of vegetable origin. *Wood-coal,* or *brown coal,* is found in low situations, and appears to have been formed of heaps of trees buried by inundations under beds of clay, sand, or gravel. The woody parts have probably undergone a certain degree of vegetable fermentation. In some specimens of this coal, the vegetable fibre or grain is susceptible in one part, and the other is reduced to mineral coal. In *black,* or *common coal,* the vegetable extract and resin are destroyed, and the *charcoal* and bitumen alone remain; but *wood-coal* and *common coal* bear, in other respects, too close a resemblance to be ascribed to a different origin, though they were probably formed from different tribes in the vegetable kingdom, and under different circumstances.

ALEXANDER. But you have said nothing to us before about *wood-coal,* nor is it in the list.

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MISS ANGERSTEIN. I will now then make amends for the omission, by telling you that it has *three* names, *brown coal, bituminous wood-coal,* and *bovey coal;* that it is of a brown colour, and in shape exactly resembles the stems and branches of trees; but is usually compressed. It is soft, rather flexible, and so light as nearly to float when thrown into water. The greatest abundance of this coal occurs at Bovey, near Exeter, from which place it derives its name. It is also found in Scotland, Ireland, Germany, and in the Island of Iceland. As fuel, the bovey coal is used only by the poorest classes of the community, as, notwithstanding its burning with a clear flame, it emits a sweetish, but extremely disagreeable sulphureous gas, which is injurious to the health. It is principally used for the burning of lime, and for the first baking of earthenware. In the Island of Iceland, where coals are rare, it is highly valued, and called *suterbrand.*

EMILY. What is the meaning of *bituminous?*

MISS ANGERSTEIN. Containing *bitumen,* which is a mineral pitch. We are now at home, for which I am not sorry, being a little tired again this morning. It is also late, you must therefore make haste and prepare for breakfast; but remember, Fanny, and tie your shoes; and do you, Emily, have your hair neatly brushed. There is always abundance of time to make yourselves neat, if you do not trifle. Let me see how quick and how neat you can both be

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CHAPTER X.

Before the conversations were again renewed, nearly a week elapsed, during which time Alexander had been with his father to Balloch Gowan, on a visit to his aunt, who wished him to remain with her till the end of his holidays; for his candid, open temper made him a great favourite with every body, more particularly as his manners were very gentlemanly, and he was perfectly good-humoured and contented. But though very fond of his aunt, he could not resolve to forego the pleasure he hoped to derive from the account of the remaining class of minerals. He told his aunt why he could not avail himself of her welcome invitation; and as his motive for leaving her was so rational, she approved of it, and told him she should be glad to see him at Christmas, when the dark and cold mornings would not allow of early walks. At the same time, finding how greatly he was interested in mineralogy, she showed him her cabinet of specimens, and explained to him many things which he would not have understood from mere description, but which the sight of the specimen made very clear and plain. He was much

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pleased with all he saw, and resolved to be very economical during the next school-time, that he might please his sisters by purchasing a few for them. He did not, however, say so to his aunt, for that would have appeared like asking *to be pouched*, (as the Eton boys term having a present of money given them,) but the resolution passed in his own secret mind; and when upon leaving Balloch Gowan, his aunt made him a present of a purse she had net for him, with a handsome sum of money in each end, saying to him at the same time, that she had pleasure in bestowing such a sum upon him now, as he knew how to make a right use of it; his bright eyes sparkled with delight, and he could not help exclaiming: "Now I shall be able to please all my sisters!" A little explanation followed, and his aunt easily penetrated the delicacy which had induced him to keep his intentions secret, and loved him the better for it.

The morning after his return to Inch Cairn, the whole party was much pleased to see the weather fine, and were very soon dressed and ready for their ramble.

"Come, dear Miss Angerstein," said the joyous boy; "we have had a long interruption; but I dare say you have a budget of interesting particulars quite ready for us; and indeed we must now make the most of every minute, for next week I must go to England, and then adieu to all my pleasant walks with you and the girls.

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MISS ANGERSTEIN. Of course; but you will then have other pleasures equally agreeable, so that there is no cause to sigh and look melancholy. Let us enjoy the few days that remain, and, as you justly observe, make the most of every minute. We did not quite finish the third class, before you went into Ross-shire. Do you remember where we left off?

ALEXANDER. Oh, yes! We have the *third genus* of *combustibles* still to consider, and I anticipate much entertainment from it. I hope it will not disappoint me as some others have done.

MISS ANGERSTEIN. I do not think it will, as it will contain an account of the diamond, which by late mineralogists is placed among combustibles, as it is supposed to be entirely composed of pure *carbon*.

ALEXANDER. But why should it be placed in the *graphite* family, which is not *pure carbon;* because, in speaking of plumbago, you told us there was a portion of iron in it?

MISS ANGERSTEIN. I suppose it is arranged in this genus, because plumbago contains so little else than carbon, its proportions being one part of iron to nine parts of carbon. It would not do for so humble an individual as myself to make a new arrangement, or I should place it as a fourth and separate genus.

ALEXANDER. I suppose it must remain where it is, but I do not feel quite satisfied about it.

MISS ANGERSTEIN. It was formerly considered as an earthy, or stony mineral, but it has been

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proved beyond a doubt *not* to be an earthy substance; it has therefore been removed from the place it so long held as the first genus among earths and stones, and placed among the combustibles, because when heated to the temperature of melted copper, and exposed to a current of air, it is found to be gradually but completely combustible. Mr. Boyle, whom I mentioned to you before, is said to be the first who subjected the diamond to the action of heat, about the year 1678. By the order of Cosmo the Third, Grand Duke of Tuscany, in 1694, the experiment was again repeated, and a diamond weighing twenty grains was exposed to the heat of a powerful burning glass, and at the end of thirty seconds it lost its transparency, separated into small pieces, and was at last entirely dissipated.

ELIZABETH. This is surely a convincing proof of the propriety of placing it among the combustibles; but from its outward appearance it seems naturally to belong to the same class as the other precious stones. The best diamonds come from the East Indies, do they not?

MISS ANGERSTEIN. Yes, my love; but they are also found in Brazil. Diamond mines have been discovered only in the kingdoms of Golconda, Visapour, Bengal, the Island of Borneo, and Brazil. There are five mines, or rather three mines and two rivers, whence diamonds are obtained. 1st. *Raolconda*, in the Carnatic, five days' journey from Golconda, and eight from Vivapour. It has been discover

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about two hundred years. 2nd. That of *Gani*, or *Conlour*, seven days' journey from Golconda eastward; it was discovered a hundred and fifty years ago, by a peasant, who on digging his ground to sow millet, accidentally found a natural fragment of twenty-five carats. From that time the whole adjacent plain began to be searched to the depth of from ten to fourteen feet, and the work was, at one time, so extensively pursued, that nearly six thousand persons were employed in it. 3rd. That of *Soumelpour*, a large town in the kingdom of Bengal, near the river Gonal, which runs into the Ganges, where the diamonds are found among the sand and gravel of the river. 4th. The fourth mine, or rather the second river, is that of *Succudan*, in the Island of Borneo, with which we are but little acquainted, strangers being prohibited from any access to it. 5th. That of *Serro do Frio*, to the north of Villa Rica, in Brazil, in which they were so abundant, that the Portuguese fleet, which arrived from Rio de Janeiro in 1730, brought no less than eleven hundred and forty-six ounces of diamonds. This unusual quantity immediately reduced the price; and to prevent this circumstance recurring, the Portuguese government determined to limit the number of men employed in the mines.

JEAN. The weight of diamonds is generally mentioned as so many carats: what is a *carat*?

MISS ANGERSTEIN. A *carat* is equal to four jeweller's grains, seven grains of which are equal to six grains of troy.

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ELIZABETH. How large have diamonds been found? I have never seen any but very small ones.

MISS ANGERSTEIN. The largest diamond ever known, is in the possession of the King of Portugal, and weighs sixteen hundred and eighty carats, or more than eleven ounces. It was found in Brazil, and sent to Lisbon in 1746. It is still uncut, and was much larger; but a piece was cleaved or broken off by the miner who chanced to find this great gem, and tried its hardness by a stroke of a hammer upon an anvil. It has been valued at above five millions and a half sterling.

JEAN. Is that the common way of using diamonds?

MISS ANGERSTEIN. To ascertain whether what has been found be really a diamond, the workmen have a mode of placing it upon a hard substance, and striking it with a hammer. If it either resist the blow, or separate into leaves, it must be a diamond; but in the latter case the discovery is sometimes made at an immense expense, as by thus diminishing the size, its value must also be greatly diminished. I must not forget to tell you, that the King of Portugal's diamond has been supposed by some to be only a white topaz.

ALEXANDER. That would make a great difference in its value, I should suppose.

MISS ANGERSTEIN. Of course it must. The next largest diamond is said to be one that adorns the sceptre of the Emperor of Russia, which is about the size of a pigeon's egg. This diamond was one

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of the eyes of a Malabar idol named *Scharingham*. A French grenadier, who had deserted from the Indian service, contrived to become one of the priests of that idol, in the hope of being able to steal this eye. He at last effected his purpose, and escaped with the diamond to Madras, where he sold it to the captain of a ship, for a sum equal to two thousand five hundred pounds of British money. It was afterwards transferred to a Jew for eighteen thousand pounds. At last a Greek merchant, named Gregory Suffras, offered it for sale at Amsterdam, in 1766; and the Russian Prince Orloff bought it for the Emgress Catherine for about ninety thousand pounds sterling, and an annuity of about four thousand pounds during the life of the person who sold it.

ALEXANDER. How amazingly it rose in value after the French thief sold it.

MISS ANGERSTEIN. He was glad to get rid of it for what he could get—not for what it was worth; the fear of detection being always before his eyes. The rajah of Mattan in the Island of Borneo, possesses a large diamond, shaped like an egg, which was found in that island about eighty years ago, and for which he was offered, by the governor of Batavia, a most immense sum, which was refused, as the Malays not only attach to it the miraculous power of curing all diseases, by means of water in which it is dipped, but also believe that the fortune of the family is sustained by its continuing in their possession.

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JEAN. Do you know what he offered for it?

MISS ANGERSTEIN. I am almost afraid of trusting my memory; but I believe it was a hundred and fifty thousand dollars, two large brigs of war, with their guns and ammunition, together with a certain number of great guns, and a quantity of powder and shot.

ALEXANDER. And was it possible to resist such tempting offers? I should have thought the powder and shot alone would have been temptation enough.

MISS ANGERSTEIN. The rajah withstood every offer that was made to him, thinking it would be highly improper to deprive his family of so valuable an hereditary possession.

ELIZABETH. Do none of the other European sovereigns, beside the Emperor of Russia and the King of Portugal, possess valuable diamonds?

MISS ANGERSTEIN. Among the crown jewels of France are two very fine diamonds, the Pitt or Regent diamond, and the Sancy. The first derived its name from having been brought to Europe by Thomas Pitt, Esq. governor of Fort George, who bought it at Madras, in December 1701, for twenty thousand, four hundred pounds; and afterwards sold it for one hundred and thirty-five thousand pounds, to the Regent Duke of Orleans. Buonaparte had it set in the handle of his sword of state, and it is now among the jewels of Charles the Tenth.

ELIZABETH. And from what did the Sancy derive its name? from a similar circumstance, I suppose.

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Miss Angerstein. There is rather a singular history attached to that diamond, which was stolen during the French Revolution, and if I recollect rightly, was never recovered.

Emily. A history! Oh! come, Fanny, this is quite in our way. I hope, ma'am, you are going to tell us all about it.

Miss Angerstein. As much as I can recollect, I will with pleasure relate to you. This diamond once belonged to Charles the Bold, the last Duke of Burgundy, who wore this valuable jewel in his hat at the battle of Nanci, January 1477, when his army was totally defeated, and he himself lost his life. It was found among the spoil by a Swiss soldier, who sold it to a French gentleman of the name of Sancy. In his family it remained above a hundred years, until a descendent of the family, who was captain of the Swiss soldiers in the service of Henry the Third, was employed by that monarch to procure him a reinforcement of soldiers from Switzerland. The king being driven from his throne, by a league which was formed against him amongst his subjects, was so totally without resources, that he was unable to send any money for the payment of the troops. He therefore borrowed Sancy's family-diamond, which was to be sent into Switzerland as a pledge. Sancy sent the jewel by one of his own servants, but the man and the diamond both disappeared. The king reproached Sancy for his credulity in trusting so valuable a treasure to a menial;

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and he, piqued both for his own credit and that of his servant, in whose fidelity he had implicit reliance, set out in search of him. He found he had been way-laid and murdered, and that his body was concealed in a forest. Sancy, still confident in the poor fellow's zeal and integrity, caused the body to be disinterred and opened; when it was found, that to preserve the jewel from the robbers, he had swallowed it. This diamond, which went always by the name of "the Sancy," afterwards became the property of the crown.

ALEXANDER. The poor servant being dead, it was impossible to reward his honesty; but to commemorate such an action, I would have called the diamond by his name, that it might have been known to all posterity.

MISS ANGERSTEIN. If he had any family, it is to be hoped they were provided for, and that would be the best way of rewarding such fidelity; but history is silent on that point. The four large diamonds which ornamented the clasp of the imperial mantle of Charlemagne, are uncut stones, and are still preserved in Paris.

ELIZABETH. Why were they uncut? They could not look so handsome as when cut and polished.

MISS ANGERSTEIN. The hardness of the diamond is such, that no steel instrument whatever can make any impression upon it. The ancients, ignorant of the art of cutting diamonds, were obliged to set them in a native state. It was not till 1456, that

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the diamond could be so polished as to exhibit its peculiar beauty; when a young man of Bruges, whose name was Berquin, endeavoured to polish two diamonds, by rubbing them against each other. Having succeeded in this, he next constructed a wheel, on which, by means of diamond powder, he was enabled to cut and polish these gems beyond his greatest expectation. Since that period the art of cutting and polishing them has been greatly improved both by the Dutch and British jewellers.

JEAN. Are diamonds always of the white colour I have seen them?

MISS ANGERSTEIN. No diamonds are so valuable as those that are perfectly transparent, and of snow-white colour; but there are green and yellow varieties, which are, however, much esteemed. The blue kinds were formerly more valued than at present; and the least valuable are those that have a grey or brownish tint. Black diamonds are much prized by collectors.

JEAN. But I have heard of *rose* diamonds: what are they?

MISS ANGERSTEIN. They are so called from the manner in which they are cut. It is usual to cut diamonds into three principal forms, called *brilliant*, *rose*, and *table* diamonds. *Brilliants* are for the most part cut from stones that have naturally a crystallized shape, and are so called from their great lustre, in consequence of the facets on both sides being cut. These are always set upon a black

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ground. *Rose* diamonds are cut from the flat varieties, and being much thinner, are set upon a white foil speckled with black, for the purpose of adding to their lustre. They are, of course, much less valuable than brilliants. The *table* diamond is the least beautiful of any; and this mode of cutting is only adopted for such stones, or rather fragments, as with a considerable breadth, have only a very trifling depth.

ELIZABETH. It is a most splendid jewel, and one that must always be in fashion. It is, however, sometimes applied to other purposes besides mere ornament.

MISS ANGERSTEIN. Yes; it is used by lapidaries for slitting hard stones, and for cutting and engraving upon other gems; by clock-makers in the finer kinds of watch and clock-work; in the glass-trade for squaring large plates of glass; and by the glaziers for cutting their glass.

ALEXANDER. As it is known what constitutes a diamond, I wonder they have not been produced artificially.

MISS ANGERSTEIN. In the latter end of the year 1828, at a meeting of the Academy of Sciences in France, a letter was read from M. Gannal, stating the result of his enquiries into the action of phosphorus brought into contact with carburet of pure sulphur. Having occasion to prepare a large quantity of carburet of sulphur, M. Gannal con-

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ceived the idea of endeavouring to separate the sulphur of this product, in order to obtain a pure carbon. Phosphorus was the material he used; and he found that the phosphorus entering into combination with the sulphur, the carbon was set at liberty in the shape of small crystals, possessing all the properties of the diamond, and especially that of scratching the hardest bodies.* I shall not enter into a detail of the experiment, but merely mention that it occupied several months; at the end of which time, twenty crystals were large enough to be taken up with the point of a penknife, and three others were of the size of a grain of millet. These last having been submitted to the inspection of an experienced jeweller in Paris, were pronounced by him to be *real diamonds.*

ELIZABETH. How very curious! I should have been delighted to possess even one of the very smallest of these artificially-formed diamonds. I suppose, however, the experiment is more curious than beneficial, as diamonds of so small a size can be of little or no value.

MISS ANGERSTEIN. Not even if they were *real* diamonds, which it is greatly suspected they are not. Indeed, I saw it mentioned in the newspapers, that a M. Thenard had satisfactorily proved it is not the diamond that has been manufactured, but a

* Vide the New Monthly Magazine, January 1829.

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beautiful species of silex; and I merely mentioned the experiment to you, to convince you that the trial has been made.

ALEXANDER. How greatly am I disappointed! But I do not yet despair of hearing it has succeeded; for to accomplish so mighty a deed, a few failures must be expected at first. I hope the trial will be again repeated, and the result may be more successful.

JEAN. Before we quit this entertaining subject, will you tell me what you mean by a *facet*?

MISS ANGERSTEIN. The term *facet* means a small surface irregularly shaped. You do very right to enquire, Jean; for though I endeavour to avoid all technical terms, they will occasionally escape me; and if you do not understand them, you have only to ask me, and I am always happy to make things as plain as I can. I think we have now done with this class, and I would recommend you to look back in your common-place books for what I told you respecting black-lead, at the very commencement of your brother's holidays; for it is useless to spend my time in repeating the same things over again, particularly as we are now a little hurried to complete this kingdom.

JEAN. We have only the fourth class, *metallic minerals*, now to consider, which you described to us as "such as are heavy, opaque, ductile, or capable of being drawn into wire; and malleable, or capable of being worked into shape."

MISS ANGERSTEIN. Exactly so, my dear Jean. Metals in a perfect state are easily distinguished

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from other minerals, by a peculiar brilliancy which pervades their whole substance, and which has the name of *metallic lustre*, by their complete opacity, and their great weight in proportion to that of other mineral substances.

ALEXANDER. Several new metals having been discovered of late years, I should like to know how many were known to the ancients.

MISS ANGERSTEIN. *Gold*, *silver*, *copper*, *iron*, *tin*, *lead*, and *murcury*, were the only metals with which the ancients were said to be acquainted; but discoveries have from time to time increased the catalogue, until it has swelled to the number of twenty-eight.

ELIZABETH. Are all the metals *malleable?*

MISS ANGERSTEIN. Only twelve have the important property of malleability. The other sixteen have therefore, by some, been termed *brittle* metals. One remarkable property of metals is their want of transparency in the mass; but as leaf-gold, when held between the eye and a luminous body, transmits a green light, and silver a white light, it seems probable that other metals, if beaten equally thin, would also be translucent.

JEAN. Which are the twelve malleable metals?

MISS ANGERSTEIN. Here is a list of them.

MALLEABLE METALS.

Platina	Lead	Zinc
Gold	Copper	Palladium
Silver	Tin	Nickel
Quicksilver	Iron	Cadmium

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BRITTLE METALS.

Arsenic	Titanium	Osmium
Antimony	Columbium	Irridium
Bismuth	Molybdena	Rhodium
Cobalt	Tungsten	Uranium
Manganese	Chrome	Cerium
Tellurium		

ELIZABETH. I think you told us that metals are *simple* substances.

MISS ANGERSTEIN. Not one of them has hitherto been decomposed, consequently they are at present considered as *simple* or *elementary* substances.

EMILY. When metals are dug out of the earth, they do not look the same as we see them when made into various articles for use.

MISS ANGERSTEIN. Certainly not. When taken from the earth, they are found in one or other of the four following states:

1. In a native state.
2. Combined with sulphur.
3. In a state of oxydation.
4. Combined with acid.

The only metals that as yet have been found in the *metallic* or *native* state, are *platina*, *gold*, *silver*, *quicksilver*, *copper*, *antimony*, *arsenic*, *tellurium*, *bismuth*, and *iron*. Even the greater part of these are rarely found quite pure, but mostly contain small proportions of other metals intermixed.

FANNY. But what are *ores*?

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MISS ANGERSTEIN. Metals found in any other than a *native state*, are called *ores*. The quantity of each metal found in the *native* or *metallic* state, is very small, except in the case of gold, which is mostly found pure.

JEAN. How do they separate the metal from the baser substances?

MISS ANGERSTEIN. After the metallic ores are drawn from the mine, they in general go through several processes before they are in a fit state for use. Some of them are first washed in running water, to clear them from earthy particles. They are then piled with combustible substances, and burnt or roasted, for the purpose of ridding them of the sulphur or arsenic with which they may happen to be combined, and which rises from them in a state of fume or smoke. Having thus been freed from impurities, they undergo the operation of melting, in furnaces constructed according to the nature of the respective metals, or the uses to which they are to be subsequently applied.

ALEXANDER. I suppose we begin with the *malleable metals* first, as they are not only the most useful and important to man, on account of their fusibility, ductility, and malleability, but comprehend also what are called the *precious metals*. I expect to learn a great deal from your kind account of them, for at present I really know little or nothing about metals; and at my age, I begin to be ashamed of ignorance upon such common subjects, and am anxious to ob-

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tain information in any way, more particularly when nothing but pleasure attends the acquirement. You have all the trouble and fatigue of searching out and arranging things, as well as the plague of repeating it all over to us; while we have nothing to do but to listen, and enquire when we do not understand you; and our road to learning is really a "royal road."

Miss Angerstein. But this "royal road" will not lead you very far towards the temple of knowledge: your own exertions and researches must follow, or you will be still an ignoramus.

Alexander. At any rate, let me enjoy and make use of it while I am at home; and if we are to begin with the twelve malleable metals, be so good as to give us some account of *platina*, which is the first on the list.

Miss Angerstein. It is placed first, because it is the most ponderous of all the metals with which we are acquainted, being twenty-three times heavier than water. It is of a white colour, between steel-grey and silver-white, and has hitherto only been found in Peru, Brazil, and in the Island of St. Domingo. It was unknown in Europe until about the year 1735, when it was first brought from South America, by Don Antonio Ulloa.

Jean. Who was Don Antonio Ulloa? A Spaniard, I suppose, from his title of Don.

Miss Angerstein. A captain in the Spanish

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army, and a good mathematician, who went, in the year 1736, to Quito in South America, to assist some French mathematicians in measuring a degree of the meridian near the equator, in order to determine the true figure of the earth.

JEAN. How could he do that?

MISS ANGERSTEIN. There are many things, my love, of which I am entirely ignorant; and as I do not understand mathematics, I cannot explain to you how he did it. All I know upon the subject is, that from the measurement of Don Ulloa near the equator, and of M. Mapertius and some other French mathematicians at Tornea in Lapland, it appears that the earth is not a perfect sphere, but an oblate spheriod, being somewhat flattened at the poles; the equatorial exceeding the polar diameter about thirty-five miles.

ALEXANDER. Now then let us go on with *platina*.

MISS ANGERSTEIN. In Peru it is found in little flat grains, rarely exceeding the size of a pea, accompanied by gold, magnetic iron-sand, and minute hyacinths; yet it is said that Baron Humboldt, the celebrated traveller, presented the King of Prussia with a mass larger than a pigeon's egg.

ELIZABETH. I suppose then platina is not found in sufficient quantities to be of any use?

MISS ANGERSTEIN. Of late it has been formed into mirrors for reflecting-telescopes, spoons, crucibles, and some vessels of considerable dimensions for the use of the chemists in particular processes.

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Could it be obtained in abundance, it would perhaps be the most valuable of all metals. The important uses to which it is applicable, may easily be imagined, from its being nearly as hard as iron, and the most intense fire and most powerful acids having scarcely any effect upon it. It is so ductile that it may be rolled into plates, or drawn into wire; and platina-wire, for strength and tenacity, is considered much preferable to that either of gold or silver of equal thickness.

ALEXANDER. Now then we come to *gold*, which I have read is nineteen times heavier than water, and which we all know is of a beautiful yellow colour; but I must enquire in what state it is usually found.

MISS ANGERSTEIN. In various states: massive, in small grains, in small scales, and capillary, or in small branches. Gold is most plentiful in hot climates. It abounds in the sands of many African rivers, and is very common in India and South America. The gold-mines of Lima and Peru have had great celebrity; but since the late commotions in the Spanish colonies, the working of them has been much neglected, and it is from Brazil that the greatest part of gold is now brought.

ELIZABETH. But as the ancients had not discovered America, they could not procure their gold from that quarter: from whence did they obtain it?

MISS ANGERSTEIN. Spain formerly possessed mines of gold: the richest was in the province of

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Asturias, where it was dug out from regular veins. These mines, according to ancient historians, were wrought by the Phœnicians, and afterwards by the Romans; but they have been totally abandoned since the discovery of America, and the mineral riches of that country. Dalmatia is said in ancient times to have produced an abundance of gold. Pliny reports, that in the reign of the Emperor Nero, fifty pounds of this precious metal were daily taken from the mines of that province, and that it was found on the surface of the ground. It is added that Vibius, who was sent by Augustus to subdue the Dalmatians, obliged that hardy and warlike people to work in the mines, and to separate the gold from the ore.

ELIZABETH. Gold is, however, occasionally found in cold climates; for James the Fifth coined some, if I recollect rightly.

MISS ANGERSTEIN. Yes, my dear: as an active and patriotic prince, he ordered the mineral wealth of Scotland to be inquired into. He obtained miners from Germany, who extracted both silver and gold from the mines of Leadhills in Lanarkshire. The gold was of fine quality, and sufficient in quantity to supply metal for a very elegant gold coin, which bearing on one side the head of James the Fifth wearing a bonnet, has been called the *bonnet-piece*. It is said that upon one occasion the king invited the ambassadors of Spain, France, and other foreign countries, to hunt with him in Crawford Moor, the

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district in which the mines were situated. They dined in the Castle of Crawford, a rude old fortress. The king made several apologies for the dinner, which was composed of the game they had killed during the hunting and hawking of the day; but assured his guests that the dessert would make them some amends, as he had given directions that it should consist of the finest fruits which the country afforded. The guests were surprised to hear the king talk of fruits being produced amidst the black moors and barren mountains around them. But the dessert made its appearance in the shape of a number of covered dishes, one of which was placed before each guest; and being examined, was found full of gold bonnet-pieces, which they were desired to accept as the fruit produced upon Crawford Moor.

ALEXANDER. And very acceptable, no doubt, the fruit proved. I dare say they found no fault with their dessert, but liked it much better than what was usually set before them upon such occasions. But is much gold found there now?

MISS ANGERSTEIN. The mines are now wrought only for lead, of which they still produce a very large quantity. The soil still furnishes gold; but the produce would by no means be equal to the expense of collecting it. Searching for gold, therefore, is now regarded only as an amusement, and not as a source of profit. Grains of this metal are sometimes found, after great floods, among the sand of brooks in different parts of Scotland.

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JEAN. Is gold ever found in England or Ireland?

MISS ANGERSTEIN. It is occasionally found in Cornwall and some other counties of England. Wherever it occurs, it is commonly observed in a state of alloy with copper or silver, and in the form of grains, plates, or small crystals. A few years ago, a single specimen of gold, equal in weight to upwards of ten guineas, was found amongst tin in Cornwall. In the county of Wicklow in Ireland, lumps of gold are occasionally found in the sands of a mountain-stream, and among the sand of the valley on each side. The largest specimen of *native gold* ever found in Europe, was discovered in that county, and weighed twenty-two ounces. Several other pieces, exceeding an ounce, have also been found at the same place. The principal gold-mines in Europe are those of Hungary and Transylvania. It has also been found in Norway and Sweden.

ELIZABETH. I had a book of *gold-leaf* once: it was so thin that my breath moved it out of its place, and it floated about in the air. How do they reduce it to so thin a substance?

MISS ANGERSTEIN. Gold is beaten into the state you mention upon a smooth block of marble. In this process there are three kinds of animal membranes used; some of which are laid between the leaves, to prevent their uniting together, and others over them, to defend them from being injured by the hammer. The interior cover is of parchment.

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For interlaying with the gold, the smoothest and closest vellum that can be procured is first used; and when the gold becomes thinner, this is exchanged for a much finer skin, made of the entrails of oxen, prepared for this express purpose, and hence called *gold-beater's skin*. After the leaf has been beaten to a sufficient degree of thinness, it is taken up by a cane instrument, thrown flat upon a leather cushion, cut to a proper size with a square frame of cane, and fitted into books of twenty-five leaves each, the paper of which has been well smoothed, and rubbed with *red bole*, to prevent them from sticking. The leaves are about three inches square, and the gold of each book weighs somewhat more than four grains and a half.

JEAN. How astonishingly thin it must be, for the twenty-five leaves to contain so little!

MISS ANGERSTEIN. Such is the ductility and tenacity of gold, that a single ounce will cover silver-wire enough to extend thirteen hundred miles in length; and sixteen ounces of gold will gild sufficient silver-wire to compass the whole earth like a hoop.

EMILY. How are the looking-glasses and picture-frames gilt?

MISS ANGERSTEIN. The frames are made of wood. The surface is first smeared with an adhesive kind of oil, or with a kind of glue called *size;* and the gold-leaf we have been talking of is then spread upon it, by a tuft of cotton or other soft substance, after which it is burnished.

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JEAN. Now then for *silver*. I do think it is such a very pretty metal, that though not so valuable as gold, I admire it quite as much, perhaps even more.

MISS ANGERSTEIN. It is a very pretty metal for many purposes; but gold will always be more admired, (independently of its greater value,) from the peculiar beauty of its colour. Like gold, it is a brilliant and ductile metal, and is found in several states. Of these the principal is denominated *native silver*, from its being nearly in a state of purity. Native silver sometimes occurs in small lumps, sometimes in a crystallized form, and sometimes in leaves, threads, or wire. In many instances the latter are so connected with each other as to resemble the branches of trees, in which case the ore is called *dendritic*. Some mineralogists reckon nine or ten species of silver ores, (which also contain many sub-species,) in which this metal is combined with lead, antimony, arsenic, sulphur, and other substances. The silver that is produced from the mines of Potosi in South America, is of the dendritic kind, and is considered by the Spaniards as the purest that is known. A range of mountains near Potosi, about twenty miles in circumference, is said to be perforated by more than three hundred shafts, or openings of mines, and to produce upon an average from thirty to forty thousand dollars' worth of ore per week. The annual produce of the silver-mines in America has been estimated at near two millions four hundred thousand pounds sterling.

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ELIZABETH. I suppose silver is found in Europe?

MISS ANGERSTEIN. Yes, my dear, in several parts. Some years ago there were mines of this metal worked at Konigsberg in Norway. These were discovered in 1623, when the town was immediately built, and peopled with German miners. In 1751 they were found so profitable, that forty-one shafts and twelve veins were wrought in this mine. The silver ore is not, as was first imagined, confined to the mountain between Konigsberg and the river Jordal, but extends its veins for several miles throughout the adjacent districts; in consequence of which new mines have been undertaken in several places, and prosperously carried on. One of the richest of these, named "Old God's Blessing," has sometimes, in the space of a week, yielded several hundred pounds weight of rich ore. The astonishing depth of this mine, which is not less than a hundred and eighty fathoms perpendicular, fills the mind of the beholder with amazement; and the circumference at the bottom forms a clear space of several hundred fathoms.

FANNY. What an odd name to give the mine—Old God's Blessing.

MISS ANGERSTEIN. It was one of the first discovered, and received the name of God's Blessing, from a feeling of gratitude towards the almighty Giver of all good, in bestowing such a treasure upon their kingdom. When others were discovered, the epithet *old* was prefixed to its former name, by way

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of distinction; but I quite agree with you, Fanny, in thinking it a singular name for a mine.

FANNY. I do not know how much a *fathom* is. Is it more than a foot? perhaps it is a yard.

JEAN. It is more than either, dear. A *fathom* is six feet, or two yards.

MISS ANGERSTEIN. You are a good mental arithmetician, Alexander, tell your sisters what the depth is in feet.

ALEXANDER, *(after a moment's pause.)* It is a prodigious depth indeed. I make it one thousand and eighty feet.

MISS ANGERSTEIN. You are right, my dear boy; that is said to be its depth.

ELIZABETH. Do the British islands furnish much silver?

MISS ANGERSTEIN. Specimens of native silver are not uncommon from some of the copper-mines of Cornwall; and many years ago, a vein of silver ore was for a short time wrought with considerable advantage, in the parish of Alva, Sterlingshire, Scotland. It is said that from forty to fifty thousand pounds worth of silver was obtained from it, before the repository was exhausted. We are informed that a mass of capillary native silver was found in veins, traversing the blue-coloured limestone of Isla, one of the western islands of Scotland. Great quantities of silver are extracted from the lead-mines in Cumberland and Westermorland. There was also fifty thousand pounds worth of this

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metal lately melted from the lead of the Beralston mines in Devonshire.

ALEXANDER. Which then are the principal countries that silver is found in?

MISS ANGERSTEIN. In Peru, Mexico, Bohemia, Saxony, Norway, Hungary, and England. It is said that in 1750 a mass of silver was found in a mine near Freyburg in Saxony, weighing upwards of one hundred and forty pounds, and another of about the same size in 1771. In the year 1748 a block of native silver and silver ore was cut out in a rich vein of silver near Schneeberg. Duke Albert of Saxony descended into the mine, and used it as a dinner-table. When this huge block was smelted, it yielded forty-four thousand pounds of silver.

ALEXANDER. I should much like to see such a block of silver as that. I must try and procure specimens of all the common metallic ores; for I shall never understand well what I read, till I can compare the substance itself with the descriptions given.

MISS ANGERSTEIN. You may easily procure small specimens to answer your purpose, at many shops in London; but more particularly at Mr. Mawe's in the Strand, where they are to be had either singly, or arranged in small or large collections, as may best suit your purse or taste.

ALEXANDER. Many thanks for this piece of information, which may prove very useful to me, if I have a few spare shillings when Christmas comes.

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ELIZABETH. The other day, when you were painting those butterflies which my uncle brought from South America, you had both gold and silver in shells. How could it be so prepared that you could use it as you do any of the common water-colours?

MISS ANGERSTEIN. By carefully grinding gold or silver-leaf with a little honey or gum-water, upon a slab or in a mortar, and then separating the honey or gum by means of water. When washed quite clean, the gold or silver may be put into shells and kept for use; when wanted for painting, it must again be diluted with a little gum-water. I dare say you have all heard of *Lunar caustic*, which is so much used by surgeons?

ALEXANDER. It never before struck me what it was composed of; but as silver is sometimes called *Luna*, or the moon, I make no doubt it is a preparation of that metal.

MISS ANGERSTEIN. You have guessed rightly. Silver dissolved in nitric acid (aqua-fortis) yields crystals, which being afterwards melted in a crucible, form that grey mass, Lunar caustic, or, as it is called by chemists, *nitrate of silver*. The other day, Elizabeth, you were marking some of your little brother's pinafores and pocket-handerchiefs, to assist your mamma. Have you any idea what the ink was composed of?

ELIZABETH. Not the least; without, indeed, it is made of nearly the same materials as common ink.

MISS ANGERSTEIN. But you know full well, my

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dear, that common ink is not indelible; or Emily's frock would have been quite spoilt when she threw the ink-stand down the other day.

ELIZABETH. Very true: salt of lemons took that all out, but it will not efface marking-ink.

MISS ANGERSTEIN. The best indelible, or marking-ink, is formed by dissolving, in a glass mortar, two drachms of nitrate of silver in six drachms of pure water, and then adding to them, by measure, two drachms of thick gum-water. The letters, though at first pale, will soon become black by exposure to light and heat.

ELIZABETH. But there is a preparation which mamma uses first: what is that composed of?

MISS ANGERSTEIN. There are so many things that are used for that purpose, that I cannot say what your mamma's may be; but the following is a very good one. Dissolve half an ounce of subcarbonate of soda in four ounces of water, and add to the solution half an ounce, by measure, of thick gum-water.

ALEXANDER. Oh, Miss Angerstein, I must ask you a question. Some of the boys at Eton are very fond of throwing small balls on the floor, and making the younger ones crush them with the heel of their shoe. They call them *fulminating balls*, and they explode with a considerable report. One boy told me they were made of silver. Do you think it possible?

MISS ANGERSTEIN. I see by your manner that you think it impossible; but a preparation called by

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chemists *fulminating silver*, was discovered in 1788, by Berthollet, and I dare say the balls you mention were filled with it. How large were they?

ALEXANDER. About the size of a pea, or perhaps a little larger: they are always covered with paper.

MISS ANGERSTEIN. I earnestly beg, my dear Alexander, that you will have nothing to do with them, for they are very dangerous things. They are small globules of thin glass, containing a grain or two of fulminating silver, which is secured by a piece of soft paper, pasted over the ball, so as completely to cover it. Fulminating bombs are similar balls, of the size of a hazel nut. None ought to attempt to crush these with their shoe, as their explosive effect is so violent, as sometimes to prove highly injurious.

ALEXANDER. But what is fulminating silver? Is it found so in the earth, or prepared by art?

MISS ANGERSTEIN. It is a peculiar preparation of the nitrate of silver and ammonia, and the most dangerous compound that is known. The mere touch of a hard substance will explode it sometimes; and its very preparation is so hazardous, that this ought never to be attempted without a mask upon the face, with strong glass eyes. I therefore once more entreat you never to amuse yourself with them, for though one fulminating ball may do no harm, from the small quantity it contains, yet if you carry several in your pocket, the accidental explosion might be attended with very serious consequences.

ALEXANDER. To remove all cause of anxiety, I

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promise you, on my word, that I will never, wilfully, have any in my possession.

Miss Angerstein. That is quite sufficient; for I have always hitherto found your word may be relied on.

Alexander. And I hope you always will, my father having early taught me the sacredness of a promise. I never make one without first considering whether I shall be able to fulfil it.

Miss Angerstein. There is no greater proof of an honourable mind, than a strict observance of a promise; and I always augur well of young people, when truth and candour are the bases of their every word and action—when they would rather undergo considerable personal inconvenience than break their word. We will now proceed to *mercury* or *quicksilver*, if you have no more questions to ask me about silver.

Jean. I do not think you have told us how much heavier than water silver is.

Miss Angerstein. I forgot to do so, my love; it is only ten times heavier than water, while mercury, of which we shall next speak, is nearly fourteen times.

Elizabeth. Then I think mercury ought to be placed next to gold, being the next to it in weight.

Miss Angerstein. Yes, my dear, in weight, but not in value. By the assent of civilized nations, gold and silver have become the representatives of wealth under the form of money; and it is now an universal

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circulating medium for the purchase of all sorts of commodities. They have been chosen to occupy this important place, on account of their scarcity, weight, and other valuable properties.

ELIZABETH. Is it known when gold and silver were first coined into money?

MISS ANGERSTEIN. Money is said to have been first made of gold and silver, at Argos in Greece, eighty-nine years before Christ. The first coining of silver took place at Rome two hundred and sixty-nine, and of gold two hundred and six, years before Christ.

JEAN. I should like to know something about our British *coins*, if you would be so good as to tell me.

MISS ANGERSTEIN. Many silver coins of our ancient Anglo-Saxon kings have been found in England, and regular series of English coins have been collected even from the reign of Egbert to the present time. *Testoons*, or shillings, were first coined in England by Henry the Seventh in 1503. The appellation of *testoon* was derived from *teste, (tête,)* or head of the king upon it. The shilling was at first a German appellation, *schelling* coins of that name having been struck at Hamburg in 1407. Silver *crowns* and *half-crowns* are said to have been first coined in the reign of Edward the Sixth. There were English crowns long before, but they were always of gold. Some pieces of gold were coined by Henry the Third, about the year 1257; but it is

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from the reign of Edward the Third that the regular series of gold coinage commences. In 1344, that prince coined *florens*, supposed to be so called from the best gold being then coined at Florence, a state where the fine arts then began faintly to dawn, and which was then worth six shillings. In the same year a *noble* was issued, value six shillings and eightpence, and forming half a *mark*; this with its subdivisions formed the only gold coin till the *angel* of Edward the Fourth, 1465, stamped with the angel St. Michael, and the dragon; and the *angelet*, or *half-angel*. Charles the Second established the coinage of *guineas*, which were struck in 1663, from gold brought by Sir Robert Holmes, from Guinea in Africa, from whence they derived the name. Charles the Second also issued half-guineas, double guineas, and five-guinea pieces. George the First coined quarter-guineas, as did his late majesty, George the Third.

ALEXANDER. What a small coin that must have been.

MISS ANGERSTEIN. They were so troublesome, from their diminutive size, and so apt to be lost, that they were stopped within a year or two after the last coinage, at the Bank, and thus silently annihilated.

JEAN. I have a very small gold coin given me by my godmamma, it is a *seven-shilling piece*.

MISS ANGERSTEIN. They were also of the late reign; but all disappeared when the new coinage of *sovereigns* and *half-sovereigns* was issued.

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JEAN. But when I asked about British coins, I hoped to hear something of those of my own dear native country; but you have told us about the English coins.

MISS ANGERSTEIN. And very little about them either; but the copper coinage we will leave till we come to that metal. And as it is very proper that you should know something about the coinage of your "own dear native country," I will gratify you by telling you all I know concerning it.

JEAN. You are always kind and ready to oblige us.

MISS ANGERSTEIN. The coinage of Scotland did not begin till a late period. There is, however, room to believe, that *silver pennies* exist of Alexander the First, 1107, as some are found of that name, apparently ruder than those of Alexander the Second in 1214. Of David, in 1124, there are coins; and those of William, in 1165, are numerous, with the inscription, LE · REI · WILLIAM, or WILLIAM RE. or RI. A large hoard of William's pennies was found near Inverness in 1780.

ALEXANDER. Tell me where, and the first time I go to make a visit to any of my friends there, I will take a mattock and spade, and try if any more are to be had.

MISS ANGERSTEIN. Silly boy! Do you think that no further search was made, when that hoard came to light? Every spot in the neighbourhood was examined, therefore you have no chance. As

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we are almost at home, let me continue my slight account of the coins of Scotland. Of Alexander the Second, who reigned till 1249, we have only a few silver pennies; but Alexander the Third, who reigned till 1293, coined *halfpence*. Of Robert the First, 1306, and David the Second, there are silver *farthings*. The *groat*, and *half-groat*, introduced by David the Second, complete the silver money till the reign of Mary, when they all ceased to be struck in silver. The gold coinage of Scotland very much resembled the English; Edward the Third having given currency in this metal in 1344. About thirty years after, Robert the Second issued some. The gold coins of Scotland, however, are upon a much smaller model than those of England. They were first called *St. Andrews*, from the figure of that tutelar saint upon his cross, which appears upon them, with the arms of Scotland upon the reverse, (a lion in a shield,) from which circumstance the largest gold coin was also called the *lion*. The *unicorn* of James the Third next followed; and the chief gold pieces of James the Fifth, were the bonnet-pieces I before told you of. The last gold coinage of Scotland is the *pistole*, and the *half-pistole*, coined by William the Third in 1701. They have the sun under the head. The copper coinage of Scotland, though more ancient than that of England, is not of so early a date as some would ascribe to it. Pinkerton says, that it did not begin before the reign of James the Third, but that it r

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creased afterwards. I have now quite exhausted my stock of knowledge about the Scotch coinage, my dear Jean; therefore, if you wish for further information, you must apply to your papa, or look in the Encyclopædia, where you may perhaps obtain what you want.

JEAN. Many thanks for what you have so kindly told us; but if you would write it upon a piece of paper, so that I might put it into my common-place book, I should be still more obliged to you.

Miss Angerstein promised to comply with Jean's request, and being arrived at home, the morning's conversation ended, and they went to prepare themselves for the social meal of breakfast, which reunited all the members of the family.

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CHAPTER XI.

"My dear Miss Angerstein," said Elizabeth, as they were walking to the cow-house the following morning, "I can scarcely tell you how much I regret that the time for Alexander's remaining with us is so nearly elapsed. We have all been so happy together—he has interested himself so much in our morning conversations—and is so cheerful and good-humoured, that we shall all feel very dull when he is gone."

"Indeed, my dear," answered her kind instructress, "we shall feel the want of his cheerful society very much the first day or two, (and I should be sorry were it otherwise,) but we shall soon fall into our old habits, and begin to look forward to his return to us in December, with great delight. The pain of parting from a beloved brother or sister, when only for a short time, is amply repaid by the exquisite pleasure of meeting again. Besides, it is for your brother's future advantage that the separation takes place; and as I have always inculcated, we must never hesitate to sacrifice a present pleasure for a future good.

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JEAN. Poor grandmamma is most to be pitied, for he is her chief darling, and she cannot bear for him to go away.

MISS ANGERSTEIN. And most deservedly is he so, for never was there a more affectionately attentive boy than he is. Does he not read to her, when she is well enough to bear it?—watch her countenance to see whether she is fatigued?—anticipate her every want and wish? and all done with a quietness peculiarly grateful to an invalid. This disposition is excellent; and his lively, happy temper, makes him a general favourite. You have all reason to regret his going away, for he has been kind and obliging to you all; and from the happiness you have lately experienced, I hope you will be convinced there is nothing more delightful than family union. But where is Alexander this morning?

EMILY. To tell you a secret, he has overslept himself. I tapped at his door as I came down to prayers, to give him some cravats nurse says he must wear this week, and I found him asleep; but he jumped up the moment Fanny and I left the room, and he called after us to say he would meet us at the bridge.

MISS ANGERSTEIN. We must walk slowly, and give him a little time, for he will not like for us to begin upon *quicksilver* till he joins us.

"And that will not be long first!" said Alexander, who came up to them at that moment. "I shall not be a minute drinking my milk, and then we must

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begin immediately upon the remainder of the metals, for my father wants me to go to Inverness with him to-morrow morning before breakfast; so that we must, if possible, finish to-day, or I shall not have time to make any memorandum in my book of the latter metals, for you to look over before I go to Eton; which I shall be sorry for, as I should like to complete this groundwork, that I may occasionally refresh my memory by reading it over. I was so pleased with the slight sketch of Zoology which you gave my sisters before I reached home, that I have copied Elizabeth's notes of the conversations for my own private use, and mean to take them with me if you have no objection.

Miss Angerstein. Not the slightest in the world; but if we are to finish the metals this morning, we must proceed to them immediately, for I have a good deal to say upon the quicksilver mines, which I think will interest you. Have any of you ever seen *mercury* or *quicksilver*?

Alexander. I have: it was in small globules of a shining, silvery appearance, perfectly fluid, but did not wet my finger when I touched it.

Miss Angerstein. It is the singular property of this metal (which has no other alliance whatever with silver than its appearance) to be capable of division, by the least effort, into an indefinite number of particles, each of which assumes a spherical form; and to be always in a fluid state in the common temperature of our atmosphere. Even during the most

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intense frost it still retains its fluidity; but by the effect of extreme cold, artificially produced, mercury becomes a solid metal, and in this state may be beaten with a hammer, and extended without breaking; but care must be taken that it does not touch the fingers, as it would blister them in the same manner as any burning substance. I told you yesterday that it was fourteen times heavier than water.

ELIZABETH. But if it is a fluid, how is it found in the earth?

MISS ANGERSTEIN. The principal ore of mercury, and that from which it is chiefly obtained, is *cinnabar*. This is of a red colour, and consists of *mercury*, mineralized with *sulphur*.

ALEXANDER. Where is mercury found?

MISS ANGERSTEIN. Quicksilver mines are worked in Carniola, the duchy of Deux Ponts or Zeveybrucken, in Lower Rhine, Spain, and Peru. The vein of Guancavelica in South America, in which quicksilver is found in the state of cinnabar, is eighty Spanish ells in extent. But those of Idria in Carniola, are supposed to be more valuable than any of the others; and require a particular description, as they have been celebrated in natural history, poetry, and romance. These mines were discovered in 1497 in a very extraordinary way.

JEAN. Oh, pray tell us how! I am so fond of any thing extraordinary.

MISS ANGERSTEIN. I was going to do so, my love, when you interrupted me. This part of the

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country was then much inhabited by coopers; and one of the men upon retiring from work in the evening, placed a new tub or pail under a dropping spring, to try if it would hold water; and when he came in the morning, he found it so heavy that he could scarcely move it. Examining into the cause of this extraordinary circumstance, the man observed that it was owing to a shining and ponderous fluid which was at the bottom. The affair was noised abroad, and a society of persons was formed to search further, and discover the mine from which this *quicksilver* had flowed. Such was their success, that the reigning Duke of Austria paid them a compensation for the discovery, and took the mine into his own possession.

JEAN. It was a very extraordinary way, certainly; but you said you would describe the mines to us.

MISS ANGERSTEIN. Here is a paper containing a description of them, which I copied some years ago from "Russel's Tour in Germany." We will sit down on this mossy bank, while you read it to us, Elizabeth.

They all gladly seated themselves, and Elizabeth read as follows:—

"The entrance to the mine is a little to the southward of the town of Idria, in the side of a small hillock, which rises in front of the mountainous wall that surrounds the dell. The visitor puts on a miner's dress, as metal buttons, watches, rings, snuff-boxes, &c. would infallibly be affected by the quicksilver. The descent can be made to the bottom of

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the mine in less than five minutes, in one of the large buckets in which the ore is brought above-ground. This mode, though the less fatiguing, is not therefore the best; for in descending the shaft on foot, one can observe much better the care and regularity with which all the operations have been carried on, particularly in later times. From the first step daylight is excluded; for the passage, hewn in the rock, descends at a very acute angle: were it a smooth surface it would be impracticable; but you descend on successive flights of steps, as regular as if they had been constructed for a private dwelling. Here and there are landing places, where galleries branch off, through which veins have been followed, or the shaft descends in a new direction. This is the regular mode in which the mining is carried on from the surface of the earth to the lowest part of the mine, forming a subterraneous staircase, descending about seven hundred feet, for the mine is as yet no deeper, owing to the superabundant richness of the ore. All is pierced in the hard limestone. A still more useful degree of care has been bestowed upon the walls and ceiling. Instead of leaving the bare, rugged rock, as is frequently the case elsewhere, or supporting the roof with wood, as was formerly the practice, this passage into the earth is lined with a strong wall of hewn stone, arched above, so that the descent is through a commodious vaulted passage about four feet wide, and an average height of rather more than six. The stones used are those cut out in carrying

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the shaft itself downwards. No mine could be more fortunate in regard to the absence of water: a slight degree of moisture on the walls and ceiling is all that can be occasionally traced. The atmosphere is perfectly dry and comfortable, excepting in the neighbourhood of rich veins. The spot where the original adventurers found the first vein of mercury, is pointed out rather more than two hundred feet below ground, that is at one-third of the depth to which the mine has been carried, during the four hundred years that have since elapsed; a striking proof how abundant and productive the veins must have proved. The deeper you go, the more thickly do the veins come upon each other. Their direction in general is nearly horizontal. The ores vary considerably in point of richness. The mercury is seldom found in a pure state, nor when it does appear, is it always in the neighbourhood of the richest veins. The only unpleasant accompaniment of the ore is the sulphur which almost universally attends it—its fumes were strongest in the lowest galleries. The miners have learnt to consider it as a prognostic of good ore; for it is universally observed, that the richer the vein is, the greater is the quantity of sulphur: they have never pure air and good ore together.

"In its flourishing state, the mine gave bread to between eleven and twelve hundred men, of whom three hundred were employed merely in felling wood in the neighbouring mountains, and conveying it to Idria. The persons employed at present do not

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amount to a third of the number. Spain formerly took annually ten thousand hundred weight of quicksilver, and upwards of one thousand hundred weight of red sublimate. The quicksilver was principally for amalgamation in the mines of South America; but this outlet is now entirely cut off. The diminution was the more sensibly felt, because it came at a time when the most active prosperity would have been required to repair the injurious consequences of a conflagration which had rendered the mine useless during nearly three years. It was never ascertained how the fire originated. The galleries were in many places then lined and roofed with wood, and in these the fire is supposed to have begun. In 1803, on the night between the 15th and 16th of March, the workmen observed a thick smoke issuing from some of the lower galleries. It ascended and spread itself through the higher. No fire was seen, no sound was heard; but it was too evident the mine was on fire below. Some of the workmen, with great intrepidity, endeavoured to reach the scene of the conflagration. It was in vain: they were forced to retreat from one gallery to another, flying before an enemy whom they could not discover; for the smoke which continued to make its way upwards to the open air, was not merely dense and suffocating, but so loaded with noxious fumes and particles let loose from the fossils, among which the flames were raging in the bowels of the earth, that no living thing could safely meet it, much less pene-

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trate it. They were fortunate enough to save themselves above-ground, and the idea was adopted of extinguishing the fire by excluding the air. All the passages were closed as near the supposed scene of conflagration as they could be reached. The two shafts which lead immediately above-ground were stopped up outside, and plaistered over with clay. Five weeks the mine remained thus sealed up, but without effect. Twice during this period the coverings above were removed ; each time the enemy was found more furious than before. The flames were heard raging below, with a sound at which the miner still trembles when he relates it. It was apprehended the fire had attacked the upper works, and was thus threatening the final destruction of the mine. As a last resource, the director resolved to hazard the experiment of laying the mine under water. A stream was turned into the perpendicular shaft, and allowed to flow two days and three nights. During the first day it produced no effect. In the course of the second day, whether it was that steam, generated by the meeting of the fire and water, was struggling for escape ; or that an inflammable air had been produced and kindled by the glowing fossils, cannot be ascertained ; but of a sudden, a subterraneous explosion shook the mountains with the noise and violence of an earthquake. The huts of the miners, situated near the entrance, were rent; houses farther off, but standing on the slope, or near the skirts of the hill, started from their foundation: the panic-

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struck inhabitants were flying in dismay from the ruin that seemed to threaten the valley. The whole thing must have been splendid; accidental as it was, art could go no further in imitating nature. In the mine itself, as was afterwards found, the explosion had rent the galleries, thrown down the arched roofs, and torn up the stairs: but the victory was gained; the vapours began to diminish, and at the end of some weeks it was possible to venture into the mine. It cost two years to construct an apparatus, and pump out the water. It was carried off into the Idria, and was found to contain only a small portion of mercury, but a large proportion of vitriolic acid; and so much iron, that the bed and banks of the river were incrusted with *iron ochre* throughout its whole course, from Idria, to where it falls into the Lisonso. At the same time, every fish disappeared from the stream, except the eel, which seems to bid defiance to every thing except broiling or roasting. Even when the galleries had been cleared of the water, it was found impossible to work in them, partly from the heat which they still retained, but still more from the fumes of *sublimed mercury*, which produced convulsions and trembling of the limbs. High wages were offered to such as would venture into places reckoned the most dangerous, to explore the consequences of the disaster, and to collect the quicksilver which had been deposited in large quantities in the galleries. Many purchased this pittance with their lives; and altogether the atmosphere, which continued

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for months to infest the mines, was so baneful, that it was difficult to muster a sufficient number of healthy men for the ordinary operations."

ELIZABETH. Poor creatures! to be in such a state of poverty, that they would risk their lives for a little extra pay! But what is *sublimed mercury*?

MISS ANGERSTEIN. I believe it is what chemists call *corrosive sublimate*, and which is a preparation of mercury with sulphuric acid and muriate of soda.

JEAN. What is an *amalgam*?

MISS ANGERSTEIN. The combination of mercury with any other metal is termed an *amalgam*—as the amalgam of tin for foliating looking-glasses; of zinc, for electricity; of gold and silver for gilding and silvering metals.

ALEXANDER. By the account I have just heard of the quicksilver mines at Idria, we know why they are celebrated in natural history; but we have yet to learn why they are so in romance and poetry.

MISS ANGERSTEIN. I am quite ready and willing to give you that information also. The Austrian government occasionally banish criminals to these pernicious and deadly caverns; and it has sometimes happened that this punishment has been allotted to persons of considerable rank and family. An instance of this nature, in the person of Count Alberti, laid the foundation of Mr. Sargent's dramatic poem enentitled "The Mine."

JEAN. Will you not be so good as to tell us this story?

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Miss Angerstein. If you wish it, my dear. The count having fought a duel with an Austrian general, against the emperor's command, and having left him for dead, was obliged to seek refuge in one of the forests of Istria, where he was apprehended, and afterwards rescued by a band of robbers, who had long infested that quarter. With these banditti he spent nine months, until, by a close investiture of the place in which they were concealed, and after a very obstinate resistance, in which the greater part of them were killed, he was taken and carried to Vienna, to be broken alive on the wheel. This punishment, by the intercession of his friends, was changed into perpetual confinement and labour in the mines of Idria—a sentence which, to a noble mind, was worse than death. To these mines he was accompanied by the countess, his lady, who belonged to one of the first families in Germany; and who, having tried every means to procure her husband's pardon without effect, resolved to share his miseries, as she could not relieve them. They were terminated, however, by his pardon being procured by the general with whom he had fought the duel, on the latter being recovered from his wounds; and this nobleman, on his return to Vienna, was again taken into favour, and restored to his rank and fortune.

Elizabeth. Surely all who fight duels deserve punishment; but to break him on the wheel, or to ·e condemned to work in the quicksilver mines, ıs carrying it too far. How I admire the conduct

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of his wife! I dare say she was a very amiable woman.

Miss Angerstein. I know nothing more of either of them, than what I have just related to you. We must now have done with amusement, leave our pleasant seat, continue our walk, and complete the account of the metals. Mercury being the heaviest of all fluids of which we have any knowledge, and not congealing in the temperature of our climate, has been preferred to all others for barometers, as a measure of the weight of the atmosphere. And as heat dilates mercury similarly to other fluids, it is likewise made into thermometers. A valuable red colour, or pigment, called vermilion, or artificial cinnabar, which was as well known to the ancients as it is to the moderns, is prepared from three parts mercury and one of sulphur. I have now done with mercury.

Alexander. Then we go to *lead*, that being next in the list, on account of its weight, I suppose; it being eleven times heavier than water, and, as we all know, is of a darkish grey colour.

Jean. Indeed, Mr. Alexander, you are very ready with your observations. Where did you learn all this?

Miss Angerstein. From books, Jean; for I saw him very busy with the Encyclopædia last night, at the article Mineralogy. But I must now deprive him of his office of speaker, and give you a few

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particulars of this metal, which has never yet been found in a native state. The most common state in which lead is found is in combination with sulphur, and a small portion of silver, when it is called *galena*. This ore is by far of the greatest importance, because from it are principally derived the immense quantities of lead required for use. This metal is also found in union with arsenic and many acids.

ELIZABETH. Where are the principal lead-mines?

MISS ANGERSTEIN. Great Britain possesses the most important lead-mines in the world; and those that are best known are in the counties of Flint and Derby. The latter are supposed to have been worked in the time of the Romans. In Scotland there are mines of it in Lanarkshire, also in most other countries in Europe. It is mentioned in the sacred writings, and is described by Homer as in common use at the period of the Trojan war. The Romans employed it to sheathe the bottoms of their ships, fastening it to the planks and timbers by nails made of bronze.

JEAN. Is lead of much use to man?

MISS ANGERSTEIN. It would be scarcely possible to enumerate all the valuable purposes to which lead is applied in the arts, in medicine, and in the common wants of man. Among its less obvious uses, lead is employed to glaze pottery, and its oxide enters into the composition of glass. Printing types are formed of four parts of lead and one of antimony,

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to which some add a little copper or brass. Great quantities are consumed for the making of shot. The different oxides of lead are of the greatest use to painters, being easily soluble in lead: the most important are white lead, or ceruse, which is made by suspending thin plates of lead over heated vinegar, which corrodes the plates, and converts them into a heavy white powder. The Roman ladies are said to have used it as a cosmetic.—*Massicot*, of a yellow colour, prepared from the drops formed by the melting of lead and red lead; or *minium*, prepared by a tedious and troublesome process, from massicot, are both used for painting.

Elizabeth. Mamma has a bottle of Goulard's Extract, which she once told me was a preparation of lead.

Miss Angerstein. Its basis, my dear, is *sugar of lead*, a most virulent poison, which is prepared either from the metal itself, or from ceruse and distilled vinegar. Diachylon plaster, which you must have seen, is prepared by boiling olive oil and litharge (another kind of oxide of lead) together, and a very useful plaster it is. I must not omit to mention, before we take our leave of this metal, that there is a very singular variety of lead ore in some of the mines of Derbyshire, called *slickenside*. This is a kind of galena, which presents to the eye a smooth and bright surface, appearing as if it were plated. It has the extraordinary property, when merely pierced with the miner's tool, of rending asunder with great violence,

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and exploding with a crackling noise. Sometimes the miners, fearless of danger, venture to scratch it with their tools, and suffer for their imprudence; for they have been seen to come out of the mine, cut violently, as if they had been stabbed about the neck and other parts of the body, in consequence of the explosion of slickenside which they had pierced. The cause of this extraordinary phenomenon has never been explained.

ALEXANDER. I think wonders increase upon us as we proceed. Metals have hitherto proved very amusing.

MISS ANGERSTEIN. I am glad you have found them so. We must now proceed to *copper*, which is about nine times heavier than water; and is the most sonorous of all metals, and the most elastic, excepting iron. It is found sometimes in masses of pure metal, but more frequently in combination with other substances, particularly sulphur. Mines of copper are largely wrought in England, Germany, Sweden, and Siberia; those of Spain, France, Hungary, Norway, and Ireland, are much less extensive and numerous. Copper has also been found in great quantities in Asia, Africa, and America.

ELIZABETH. I think you said copper was known to the ancients.

MISS ANGERSTEIN. The use of copper is probably of greater antiquity than that of any other metal. It is mentioned in the Old Testament; and during the Trojan war, Homer describes the combatants as

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having no other armour than what was made of *bronze*, which is an *alloy* of copper, consisting of from six to twelve parts of tin, combined with one hundred parts of copper.

ALEXANDER. While you take breath, I must ask Jean's usual question: "What are the particular uses of copper?"

MISS ANGERSTEIN. The uses of copper, in all its various states, are almost endless, and only, if at all, inferior to those of iron. Alloyed with certain proportions of zinc, it forms *brass*, *pinchbeck*, *tinsel*, and *Dutch gold*, in imitation of gold-leaf. With a small proportion of tin it forms *bronze*, or *bell metal;* but if the proportion amount to one-third, it forms *speculum metal*, used for reflecting telescopes. With zinc and iron it forms *tutenag*, a well-known white metal used for making candlesticks and other articles; and with an equal proportion of *arsenic*, white copper. In porcelain painting the *green* is obtained from copper.

ELIZABETH. I suppose that is *verdigris*, which I know is a preparation of copper.

MISS ANGERSTEIN. It is so; verdigris is an oxide of copper, usually prepared from that metal by corroding it with vinegar. There is a large manufactory at Montpelier in France, where the workmen place alternate layers of copper plates and husks of grapes, the latter of which speedily become acid, and corrode the copper. The verdigris thus formed is scraped off as it collects on the surface; it is after-

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wards dried and put in bags or casks. You must not forget that the turquoise, of which you are all so fond, is supposed to be *bones* or teeth of animals, impregnated with *blue oxide of copper*. There is a beautiful mineral, produced in the Vosges mountains of Lorraine, in the copper mines of Saxony, Cornwall, and Wales, called *malachite*, which resembles green jasper, but is not so hard. It is made into brooches, necklaces, and bracelets; cut into slabs, and mounted into snuff-boxes. The finest specimens of this mineral, in Europe, are some slabs that are adapted as the tops of tables, sideboards, &c. at the *Trianon* in the park of Versailles. The largest of these are nearly four feet in length and two feet wide. Smaller pieces of this substance that are used for trinkets, are about the same value as cornelian.

JEAN. It must be very pretty: I should like to see it.

MISS ANGERSTEIN. I can show you a small piece I have, cut as a brooch-stone, but not set.

JEAN. I shall remind you some day when you are in your room, and at liberty.

MISS ANGERSTEIN. Do so, my dear. The next metal we must consider is *tin*, which in its pure state is about seven times heavier than water, and has never yet been found quite pure; being always discovered either in a state of oxide, or in combination with sulphur or copper.

EMILY. Was it not for tin that the Phœnicians came to England?

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MISS ANGERSTEIN. So it is said, my little girl. At any rate, tin is always considered to be one of the oldest metals, because it is principally found in the most ancient of those rocks, which from their not containing any animal or vegetable remains, are termed *primitive;* and Diodorus Siculus, who wrote forty years before Christ, gives an account of the tin-mines of Cornwall, and says that their produce was conveyed to Gaul, and thence to different parts of Italy.

ALEXANDER. But other nations possess tin-mines besides England; do they not?

MISS ANGERSTEIN. It is most abundant in Cornwall and the western part of Devonshire; but it is also found in Spain, in Saxony, and in Bohemia, besides two or three small veins which have been lately discovered in France. In Asia it is found in the peninsula of Malacca, and in the Island of Banca; and in Chili and Mexico in South America.

ALEXANDER. The Prince of Wales, as Duke of Cornwall, derives a considerable revenue from the tin-mines; but I should like to know in what way. Has he a certain portion of the tin?

MISS ANGERSTEIN. When the tin is separated from the ore, and reduced to a metallic state, it is poured into quadrangular moulds of stone, each containing about three hundred and twenty pounds weight. These have the denomination of *block* tin, and are stamped by officers of the Duke of Cornwall, on paying a duty of four shillings the hundred weight,

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which stamp it must receive before it can be offered for sale.

ELIZABETH. And except for saucepans and such things, is tin of any use?

MISS ANGERSTEIN. I have just told you it is an ingredient in bell-metal and bronze; it is also a principal one in *pewter*, of which there are three kinds, *plate*, *trifle*, and *ley* pewter. The first, which is made into plates and dishes, is formed of tin, with a small proportion of lead and antimony; the second, or *trifle* pewter, is formed of somewhat different proportion, and used for the quart and pint pots of the publicans; and the *ley* pewter, which is formed of three parts of tin and one of lead, is manufactured into wine and spirit measures. In the fine leaf constituting *tin foil*, it is used for many purposes. The *oxide of tin* is also an important article to dyers, giving brightness to such colours as are used in forming scarlets and reds. Putty, which is employed in polishing glass, steel, and other hard substances, is a preparation of the oxide of tin. We must now turn our attention to *iron*, which is one of the most useful, and the most copiously and variously dispersed metals of the whole. When cast, iron is about seven times heavier than water; but wrought or hammered iron is nearly eight.

JEAN. What do you mean by *cast* iron and *hammered* iron?

MISS ANGERSTEIN. After iron has been run down in the furnace from the ore, it is suffered to flow

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through a channel of sand into moulds; and in this state it is termed *cast* iron; of which stoves, pipes, &c. are made more cheaply than of *hammered* iron. To render iron ductile and malleable, it is again melted and kneaded in the furnace, afterwards hammered and forged into plates and bars, and in this state is termed bar or hammered iron. Iron is converted into *steel* by being exposed to the action of heat, in contact with powdered charcoal, the carbon from which penetrates its substance; and it is tempered when red hot, by plunging it into cold water, by which it becomes harder, more elastic, and brittle. The steel which has been most celebrated in this country, is that imported from Syria, under the name of *Damascus steel.*

ELIZABETH. In what countries does iron abound?

MISS ANGERSTEIN. The most considerable iron-mines at present existing are those in Great Britain and France. It is also found in Bohemia, Saxony, Bavaria, Russia, Siberia, Norway, and Sweden; the iron of this last country is considered superior to that of any other in Europe for the manufacture of steel. Indeed, it occurs abundantly in almost every country in the world. It is seldom found in a native state, but as an oxide, and mineralized with sulphuric, carbonic, and other acids. It is found also in plants, in several coloured stones, and even in the blood of animals.

ELIZABETH. That is extraordinary!

MISS ANGERSTEIN. I cannot explain this to you just now; but if you will look into the second vo-

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lume of "Conversations on Chemistry," you will be much interested with what is there said. I must not forget to tell you, that steel is capable of receiving a permanent magnetic property, which has led to the discovery of the *mariner's compass*. Had iron been productive of no other advantage to mankind than this, it would on this account alone have been entitled to their greatest consideration.

ALEXANDER. Who discovered the mariner's compass?

MISS ANGERSTEIN. It has been much disputed who was the inventor of the compass; but the honour is usually ascribed to Flavio di Giovia, a native of Amalfi, an ancient commercial city in the kingdom of Naples, in the year 1303.

ELIZABETH. Is not the *magnet*, or *loadstone*, a sort of iron ore?

MISS ANGERSTEIN. The magnet is found in masses of different form and size in most of the iron mines of Europe and America, and when submitted to the furnace, yields a considerable proportion of metal. Various parts of the world produce them, but the best are brought from China and Bengal. We are, however, entirely ignorant what is the cause of the very extraordinary property with which it is endowed, of not only attracting iron, but also of pointing itself, and of enabling a needle touched with it to point, towards the poles of the world.

ALEXANDER. What are *iron pyrites*, of which I have read the name somewhere or other?

MISS ANGERSTEIN. It is a mineral substance

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formed by a combination of iron with sulphur; and to the decomposition of this mineral it is that the hot temperature of almost all the mineral waters may be ascribed. It is sometimes called *marcasite*, and if skilfully cut in the form of small rose diamonds, although an opaque substance, it has somewhat the appearance of a diamond. In the tombs of the Peruvian princes, with whom a considerable portion of their valuables was always interred, there have been found polished plates of marcasite, which appear to have served them as mirrors. The property of this mineral, of striking sparks from steel, procured it the name of pyrites, which in the Greek language signifies *fire-stone*. Red-ochre, reddle, or red-chalk, is an iron ore of blood red colour. The principal use of red-chalk is for drawing, and also for painting; but for these purposes it is prepared. Under the name of reddle, the coarse kinds, for the marking of sheep; and as red ochre, (when mixed with oil,) for the painting of pales, gates, and the woodwork of out-buildings. What do you think *umber* is?

ELIZABETH. From your asking me just now, I conclude it is an iron ore.

MISS ANGERSTEIN. It is rather a compound of the ores of iron and manganese, and is found in beds in the Island of Cyprus, and is used in painting, both in a raw state and burnt. *Zinc* is the next metal to come under consideration.

ALEXANDER. Either you told me, or I have read, that the principal ores from which this metal is pro-

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cured, are known by the names of *calamine* and *blende*. What are they composed of?

Miss Angerstein. *Calamine* is an oxide of zinc, combined with carbonic acid. Zinc, as an oxide, combined with iron, sulphur, silex, and water, forms the ore called *blende;* and various as are the ores of this metal, it is never found in the pure or native state.

Elizabeth. How heavy is zinc, and what are its uses?

Miss Angerstein. About seven times heavier than water. In China it is employed for coins. The principal use of calamine is in the manufacture of brass; and the mines of Derbyshire, and of Linberg in the Netherlands, supply with this mineral nearly all the brass works in Europe. The use of calamine in the composition of brass was known at a very early period, for it is mentioned by Aristotle.

Emily. Of what colour is zinc?

Miss Angerstein. Zinc, which in commerce is called *spelter*, is a bluish grey metal, entering into the composition of brass, pinchbeck, bronze, and tutenag.

Alexander. *Palladium* is the next metal.

Miss Angerstein. Which will not occupy us long. It is about eleven times heavier than water; it is very malleable, and somewhat harder than bar-iron. It occurs alloying the native platina of Brazil, which it greatly resembles in colour; but has never been applied to any use.

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ALEXANDER. Very laconic indeed! Will *nickel* prove equally so?

MISS ANGERSTEIN. You shall judge for yourself. *Nickel* is about nine times heavier than water, and when pure, is a fine white metal, something like silver in appearance; but it is attracted by the magnet, and has itself the property of attracting iron. It has never been found in a pure state, but combined with arsenic and other metals. It is found in Cornwall, Germany, Sweden, France, Spain, and several parts of Asia.

ELIZABETH. It seems a curious metal, and must be of some use, I should think.

MISS ANGERSTEIN. The Chinese employ it in making white copper, and they manufacture it into a variety of children's toys. As it gives a certain degree of whiteness to iron, it is used with advantage by some of the Birmingham manufacturers, in combination with that metal, and by others in combination with brass. The *oxyde of nickel* is used for giving colours to enamels and porcelain. In different mixtures it produces brown, red, and grass-green tints.

ALEXANDER. I am afraid we are coming among those metals which afford but a concise story; for the next is *cadmium*.

MISS ANGERSTEIN. This will be concise, most certainly; for it is but very little known. It was discovered in the oxyde of zinc, prepared for medicinal use from an ore of zinc found in Silesia; and it has since been found in some of the ores of that

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metal in England. *Cadmium* resembles tin in colour, lustre, softness, ductility, and in the sound it emits when bent. It is about eight times the weight of water.

JEAN. Now then we have finished the twelve malleable metals, and have only those to chat about that you called *brittle* or *semi-metals*, the first of which I think is *arsenic*. You have the list Alexander.

MISS ANGERSTEIN. You are quite right, my love: arsenic is generally placed the first of the semi-metals. It is the softest of all known metals, and is rather more than eight times heavier than water. It is found nearly pure, and in considerable abundance, in various parts of Germany, and is extremely injurious to the workmen; for being very volatile, its fumes effect and destroy the lungs, and occasion death in a short time to many of them. One of its ores, *arsenical pyrites*, is found abundantly in Cornwall in Devonshire, accompanying ores of copper and tin; and in combination with other metals, it occurs, in a greater or less proportion, in almost all mines.

ALEXANDER. I have seen what was called arsenic, but it did not look like a metal: it was more like salt or white powdered sugar.

MISS ANGERSTEIN. The arsenic you have seen was that prepared from the oxyde, by a process called *sublimation*.

JEAN. What is *sublimation*?

MISS ANGERSTEIN. A chemical process by which

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volatile substances are raised by heat, and again condensed by cold into a solid form: it resembles distillation in its principles. Arsenic is one of the least useful metals, and though a strong poison, is used in medicine, also in the making of glass.

ALEXANDER. Are there any peculiar ores of arsenic?

MISS ANGERSTEIN. Yes: it occurs combined with twenty-five parts of sulphur, forming an ore of a red or orange colour, called *realgar* or *red orpiment*, which is found in Sicily, Hungary, and various parts of Germany, and is very common in several districts of China. It is in considerable request by painters, dyers, and calico-printers. In China it is manufactured into small pagodas and other ornaments. *Yellow orpiment* is another ore in which arsenic is combined with a larger proportion of sulphur, and is chiefly imported from different parts of the Levant, produced by an artificial process. In a natural state, it is found along with copper and other ores in Natolia, Servia, Hungary, Turkey, and some other countries. The beautiful pigment, called *king's yellow*, is prepared from this mineral.

ELIZABETH. *Antimony* is the next metal.

MISS ANGERSTEIN. Antimony is a compact, brittle, bluish-white metal, about seven times heavier than water. Its texture is laminated, the plates crossing each other in almost every direction. It is as hard as silver, and so brittle that it may easily be reduced to powder in a mortar. Its ores are not

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numerous, and it occurs mineralized by sulphur and oxygen.

ALEXANDER. Is it never found in a pure state?

MISS ANGERSTEIN. Yes; native antimony is found in the mountains of Dauphiné and in the Hartz. In North America, in the state of Connecticut, antimony is said to be found in a pure metallic state, in such abundance, that in some places large masses of it may be seen on the surface of the ground.

ELIZABETH. Then I suppose all Europe is supplied with this metal from Connecticut.

MISS ANGERSTEIN. No, my love; Europe is principally supplied from an ore which is found in Hungary and Norway, called *sulphuret of antimony*. In the British Isles there is but one known mine of antimony, and that is at Glendinning in Dumfriesshire, but it is not now worked.

JEAN. Is it much used in medicine? Nurse used to give us antimonial wine, when we had the hooping-cough.

MISS ANGERSTEIN. That is one preparation of it, which is much used in medicine, as are emetic tartar and James's powder, besides a variety of others. And it is to the alchemists that we are chiefly indebted for these most valuable medicines; for it was on this metal they principally founded their hope of discovering the philosopher's stone, and it is through their experiments that many of these preparations of antimony were brought to light.

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JEAN. And is it useful in no other way than in medicine?

MISS ANGERSTEIN. When speaking of lead, I told you its use, with that of metal, in forming printers' types. The plates on which music is engraved are formed of a mixture of tin and antimony; and the oxydes of antimony are used for the colouring of glass.

ALEXANDER. These metals are dismissed very quickly, yet I fear we shall reach home before we have mentioned all. *Bismuth* is the next on the list.

MISS ANGERSTEIN. We shall have plenty of time. Bismuth is a reddish-white semi-metal, harder than silver, and composed of broad, brilliant plates adhering together. It is nearly ten times heavier than water, and breaks readily under the hammer. None of the semi-metals are so easily to be fused as this; and it has the singular property of expanding as it cools.

ALEXANDER. Is it found in great abundance?

MISS ANGERSTEIN. It is a rare metal, but is sometimes found in a native state. It is not of much use in the arts, but its fusibility admirably adapts it for the composition of the soft solders; and it is also used for giving hardness to tin and other metals. The ores of bismuth chiefly occur in Sweden, Norway, Germany, France, and England. Have you ever seen a spoon, looking very much like silver, dissolved in boiling water?

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ALEXANDER. Oh, no!

MISS ANGERSTEIN. But I have.

Many voices at once. Oh, do tell us about it! How very curious that must be!

MISS ANGERSTEIN. A very singular metal is formed by melting together eight parts of bismuth, five of lead, and three of tin. Tea-spoons formed of this metal, and thrown into boiling water, will melt immediately. Sir Isaac Newton discovered this very fusible metal.

ALEXANDER. I think I must try that experiment: it seems so very surprising that any metal should melt so easily.

MISS ANGERSTEIN. *Cobalt*, of which we must next speak, is of a grey colour with a red tinge, and has the magnetic properties of iron; but it is difficult of fusion, brittle, and easily reducible to powder. Its ores are not numerous, and are for the most part combinations of this substance with other metals, or of its oxydes with arsenic or with sulphuric acid. The name of this metal is derived from the German, and signifies an evil being or goblin (kobold) and is said to have been given to it on account of the vapour of the arsenic which issues from it tormenting the miners, and making them imagine that they are afflicted by wicked spirits; and so firmly was it believed by all classes, that it was once customary in Germany to introduce into the church-service a prayer, that God would preserve miners and their works from cobalts and spirits.

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JEAN. What a state of ignorance they must have been in!

MISS ANGERSTEIN. Before knowledge was so well diffused, every thing that could not be readily accounted for, was attributed to evil spirits or to witches. Cobalt was not known as a metal till 1733, when it was discovered by Brandt, the celebrated Swedish chemist. It is of little value in its metallic state, but as an oxyde it is found extremely valuable in painting, enamelling, and in the colouring of porcelain; cobalt and ultrama zinc forming the most permanent blue colours with which we are acquainted. Cobalt is brought to this country in the state of an oxyde, of an intense blue colour, called *zaffre*, which when melted with three parts of sand and one of potash, forms a blue glass, which when pounded very fine, is called *smalt*. Zaffre has been chiefly imported into this country from Saxony and Bohemia, but it is now also manufactured from cobalt dug from mines in the Mendip Hills and in Cornwall. There is a considerable trade carried on in Staffordshire, in preparing this colour for the earthenware-manufacturers of that county.

ELIZABETH. I use ultramarine in my flower-painting, but I have not the least idea what it is prepared from.

MISS ANGERSTEIN. From the azure stone or lapis lazuli, which you will find in the list of the siliceous genus, which is principally brought from Persia, Natolia, and China; but it is also found in Siberia

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and Tartary. In Europe lapis lazuli has been discovered only in Germany, and among the ruins of Rome.

ELIZABETH. I also use smalt in painting; but is it of no other use?

MISS ANGERSTEIN. It is employed to give a blue tinge to writing-papers, and in the preparation of cloths, laces, linens, muslins, &c. Have you any idea what powder-blue is made of?

ELIZABETH. Not the least. Yet as you say smalt is used in the preparation of linen, &c. I should not wonder if it were manufactured from either zaffre or smalt.

MISS ANGERSTEIN. It is smalt reduced to a perfectly fine or impalpable powder. Zaffre is used to colour glass; and so intense is its blue colour, that one grain will give a full blue to two hundred and forty grains of glass.

JEAN. Cobalt has proved a very interesting metal, I hope *manganese* will be so too. I think I have read that it is a most useful metal.

MISS ANGERSTEIN. It is employed for various useful purposes. In the manufacture of the finer kinds of glass it is used in a double capacity, both as a colouring material, and as a destroyer of colour; and curious as is this application of it, it is very ancient, being mentioned by Pliny. It destroys colour by the oxygen it gives out, when applied in small quantities; and this property has obtained for it the appellation of *soap-glass*.

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ELIZABETH. What sort of a metal is it?

MISS ANGERSTEIN. *Manganese* is an iron-grey colour, seven times heavier than water; and it has so strong an attraction for oxygen, that it absorbs it from the atmosphere at any known temperature. It is therefore seldom found in a metallic state, but always as an oxyde, in which state it has very little appearance of a metal. Mines of it have long been worked in several parts of Great Britain, but particularly in the counties of Devon and Somerset. Near Exeter, and in the Mendip Hills, this mineral is found in great abundance.

ALEXANDER. What fine stuff it would be to obtain oxygen gas from. Is it ever used in that way?

MISS ANGERSTEIN. All the oxygen gas used by chemists is obtained from it. By the application of a red heat, an ounce of the oxyde of manganese will yield about two quarts of gas. The demand for manganese has greatly increased of late years, since the discovery of *oxygenated muriatic acid*, which is prepared by the distillation of the oxyde of manganese with muriatic acid, and which is now extensively used in the bleaching of linen and cotton.

JEAN. What colours will manganese give to glass?

MISS ANGERSTEIN. Red, purple, and violet. Who can tell me what the next metal is?

ELIZABETH. *Tellurium.*

MISS ANGERSTEIN. Which will soon be dismissed, as it has never been made any use of. It is

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found in Transylvania and Siberia, and when pure is about the colour of tin; is a very rare metal; brittle, nearly as fusible as lead, and about six times the weight of water.

ALEXANDER. *Titanium* comes next.

MISS ANGERSTEIN. Which is so difficult of fusion, that the attempts to reduce it to a pure metallic state have scarcely succeeded; but it occurs in brilliant cubes, which are very small and of a copper red colour, in the *slag* of the iron-works of Merthyr Tydvil in South Wales, and is about six times heavier than water.

EMILY. What is *slag*?

MISS ANGERSTEIN. Slag means the dross or refuse of any metal. The ores of titanium occur sparingly in Hungary, Transylvania, France, Britain, and North and South America. The only use to which titanium has ever been put, was in the porcelain manufactory at Sevres, near Paris, where it was employed to produce the rich browns for painting, but the want of uniformity of colour occasioned its disuse.

JEAN. *Columbium*, you told me the other day, derived its name from having been first discovered in North America.

MISS ANGERSTEIN. I did so, my love. It is a very rare mineral, but has also been found in Finland and Sweden. It is of a dark-grey colour internally, and is little more than six times the weight of water.

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ALEXANDER. *Molybdena* is a more important metal, I suppose, because it furnishes the *molybdic acid*.

MISS ANGERSTEIN. It does so; but this metal has never been found pure in but very small quantities, and has not yet been applied to any use. It occurs in Bohemia, Saxony, Sweden, France, and England; is of a greyish-white, and about eight times heavier than water.

ALEXANDER. As the base of the tungstic acid, I have also heard of the next metal, *tungsten*.

MISS ANGERSTEIN. And as the only use to which *tungsten* has been hitherto applied is in the arts, as forming, in combination with other substances, those red paints known by the name of lake, it will not occupy much of our time. It is found accompanied by quartz and tin ores, in Bohemia, France, and Cornwall in England. It is never found pure, but in the state of an oxyde, or of an acid combined with other substances. It is above seventeen times heavier than water, in its pure metallic state, and is of a light steel-grey colour, very hard and brittle. You have also heard of *chrome* or *chromium* as the base of the chromic acid.

ELIZABETH. Merely by name, as you p[illegible] the chromic acid with only stating it was [illegible] acid.

MISS ANGERSTEIN. Well, I will now [illegible] amends I can, by telling you that chrome is [illegible] of a greyish-white colour, extremely brittle [illegible]

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not six times heavier than water. Like tungsten it has never been found pure in the metallic form, but in the state of an oxyde, which is its only ore.

ALEXANDER. But that is nothing about its acid.

MISS ANGERSTEIN. I know so very little about the acid, that I hardly thought it worth while mentioning; but as you seem anxious to be put in possession of that little, listen, and you shall have it. The *chromic acid* is found mineralizing lead, and forming the compound mineral called *chromate of lead*, which, on account of its beautiful red colour, has been employed in Russia as a paint. *Chromate of lead* has been principally found in mica slate, in a gold-mine in the Uralian Mountains in Siberia. It is said also to have occurred at Annaberg in Austria, and at Trappettes in Savoy, and is commonly reckoned among the ores of lead.

ALEXANDER. That is infinitely preferable to knowing nothing about it, and I am very much obliged to you for this short account. Where is chromium found?

MISS ANGERSTEIN. Chrome, in the state of an oxyde, has been detected by analysis, as an ingredient in the emerald and two or three other earthy minerals; and in the acid state, in the spinelle ruby. There is a mineral, called *chromate of iron*, in which the oxyde of chrome is found in combination with oxyde of iron, alumine, and silex; and which is found in France, in North America, and in some places in Siberia.

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ELIZABETH. Has this metal been found of any use?

MISS ANGERSTEIN. Chrome, obtained by the chemist in the metallic state, from either of the chromates of iron or lead, has not been as yet applied to any important use. It tinges glass of a green colour, and may therefore probably be hereafter employed as a paint. The three next metals, *osmium*, *iridium*, *rhodium*, have never hitherto been applied to any use, and very little is known about them. They are very brittle metals, and have by analysis, together with palladium, (which we noticed in the malleable metals,) been found in combination with platina.

JEAN. What do you mean by *analysis*, which you have just twice mentioned?

MISS ANGERSTEIN. It is the method employed by chemists to separate compound bodies into their constituent parts. Having told you all I know of these three metals, we must pass on to *uranium*, of which I have not much more to say; for it has never been found in any state having a metallic appearance, consequently never in the pure state. It is a brittle, granular, hard metal, very difficult to fuse, of a reddish-brown colour, and about six times heavier than water.

ELIZABETH. Has it many ores? and where is it found?

MISS ANGERSTEIN. Only two ores have been discovered, and they are not common: they have

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been found in Saxony, Bohemia, Norway, France, and England. The *phosphate of uranium* is a beautiful mineral, mostly in small thin plates of a fine green colour, and transparent. No use has hitherto been made of uranium.

JEAN. Alexander, you are the keeper of the list; but if my memory is correct, we are now arrived at the last of the twenty-eight metals, *cerium*.

ALEXANDER. Your memory in this instance is correct, Jean, for *cerium* is the next metal and the last.

MISS ANGERSTEIN. Which has only hitherto been obtained in the metallic form, in very minute quantity. From the *cerite*, which has been found only in the copper-mine of Bastnaes, at Riddarhytta in Sweden, cerium, in the state of an oyde, is combined with iron, silex, lime, and water. This metal has never been applied to any use.

JEAN. And is that all you have to tell us?

MISS ANGERSTEIN. Yes, my dear, we have now completed a slight sketch of the mineral kingdom, from which I trust you have derived both amusement and instruction.

ALEXANDER. I have been more interested in these conversations than I had thought possible, and I do most gratefully thank you for having admitted me to them. An entire new field has been opened to my mind's eye, and I have learnt a great deal from your remarks—and that is, how sadly ignorant I am of almost everything, except what is connected with the "dead languages."

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Miss Angerstein. But do not suppose that you have acquired much real knowledge of mineralogy, during this short time that we have been discussing the subject, for it is a science which requires deep and close study to make any progress in it. All I attempted, was to give you a few general ideas, and to awaken in all your minds, but more particularly in your sisters', a spirit of observation and enquiry. If I find I have succeeded in this, I shall be perfectly satisfied. We have just finished in time; for besides being at home, I hear the breakfast-bell ringing. Enter what you can recollect of this morning's conversation in your common-place book, or rather your book of extracts: leave it with me, and while you are in Inverness I will look it over, and then it will be ready to pack up.

Alexander. How I shall long for the Christmas holidays! To be once more at home with you all will indeed be a great happiness. I must go to my dear aunt's part of the time, but as she means to ask you, Miss Angerstein, and some of my sisters, to accompany papa and mamma, why it will be like being all happy at home: only I shall not like for dear grandmamma to be left alone.

Miss Angerstein. You may be assured, my dear boy, that either your mamma or I shall stay with her, for you know she is never left to the servants' care only—but we must not talk any longer. There! your papa is beckoning to us.

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The following day Alexander went to Inverness, and in the course of the week his mother and sisters took a sorrowful leave of him. His father accompanied him to Perth, where, after spending a day or two at Drylands, (the residence of Mr. M'Ivor's married sister,) and seeing him safely into the London mail, they parted; but not till the grateful boy had purchased a handsome silver fruit-knife, which he charged his father to present to Miss Angerstein in his name, as a trifling acknowledgment of her kind attention to him, and which she preserved for many a long year afterwards.

So long as the weather permitted the continuance of the morning walks, Miss Angerstein and her pupils frequently conversed upon mineralogy; and she promised, that if they were diligent at their studies during the winter, and persevered in the correction of their faults, she would, when the spring was sufficiently advanced, resume the early walks, and give them an insight into the delightful study of Botany; from which she thought they would derive still greater pleasure than they had hitherto received from Zoology or Mineralogy.

While the weather was mild their dear grandmamma continued to enjoy her daily ride in the Bath chair; from which she derived so much benefit, and gained such an increase of strength from the

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air, that before the winter closed in she was enabled to move from one room to the other, with merely the support of her daughter's arm. This was indeed a rich reward to Alexander for the victory he had gained over his thoughtless waste of money, and quite established him in his good resolutions.

THE END.

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